UNITED STATES COAST GUARD

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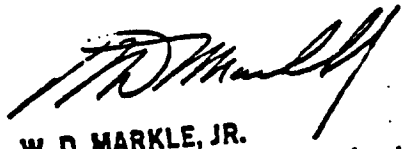
NAVIGATION AND VESSEL INSPECTION CIRCULAR NO. 6-80

Subj.: Guide to Structural Fire Protection Aboard Merchant Vessels

1. PURP0SE. This guide has been prepared to explain the Coast Guard structural fir. protection regulations. It is intended to serve as an explanation of accepted practices which have been found to comply with the intent of the regulations.

2. DIRECTIVE AFFECTED. This Circular and enclosed guide supersedes the previously issued NVC 10-63.

3. DISCUSSION. Enclosure (1) is a guide detailing typical, acceptable methods of complying with the Coast Guard structural fire protection regulations. It must be remembered that other alternatives may be equally acceptable based upon specific application. This guide is intended as an illustrative aid for Coast Guard technical units, marine inspectors, materials manufacturers, vessel owners, designers and others who deal in the design and approval of shipboard structural fire protection. Nothing contained in. this guide shall be taken as amending the applicable requirements set forth in the Code of Federal Regulations, nor as limiting the authority of the Officer in Charge, Marine Inspection in his determination of acceptable materials and installation methods.



W. D. MARKLE, JR.
Acting Chief, Office of Merchant Marine Safety

Encl: (1) Guide to Structural Fire Protection Aboard Merchant Vessels

Ce: Baltimore (75); San Francisco, Mobile, Guan, Pittsburgh. Providence. Norfolk (50); Galveston (30); Cleveland, Portland 0R, Sturgeon Say (25); San Diego, Savannah, Buffalo, Corpus Christi (20); Tampa, Milwaukee, Nashville, Detroit, Toledo, Anchorage (15); Portland ME, Duluth, Charleston,. Huntington, Minneapolis-St Paul (Dubugue). San Juan (10); Juneau, Cincinnati, Memphis, Wilmington, Paducah, Albany (5) extra

Cm: New Orleans (250); New York (200); Seattle (100); Houston (50); Terminal Is (LA-L3). Philadelphia (40) extra

GUIDE TO STRUCTURAL FIRE PROTECTI0N ABOARD MERCHANT VESSELS

1. Introduction

This guide is intended to clarify the structural fire protection requirements for merchant vessels contained in Title 46 of the Code of Federal Regulations. It is generally accepted that the regulations without explanation may be insufficient for the comprehension of the total scope and intent of the Coast Guard'5 structural fire protection system. This guide is a clarification and interpretation of the regulations, and in no way changes or modifies the applicable requirements

Requirements for structural fire protection on board merchant vessels have been formulated as a complete system, and for total effectiveness, all aspects of the system must be incorporated into a vessel design. It is important to realize that the primary function of structural fire protection is to provide for the life safety of personnel on board a vessel during periods of fire exposure and must be considered from a different viewpoint than life safety in holdings. Generally, in a building. escape from a fire zone is made in the opposite direction of flame spread; however, on board vessels, escape-to the -lifeboats is often in the same direction as flame spread.

Aboard vessels, potential high fire risk areas such as machinery spaces and cargo spaces must be separated from accommodation areas by structural and thermal boundaries. within accommodation areas, means of escape including corridors and stairways must be adequately protected. It is important that these escape routes are correctly protected and placed and, further, that the integrity of each is maintained at all junctions and penetrations. In the following sections each component of the structural fire protection system will be explained and the component’s function within the total system will be more clearly defined. However, the total structural fire protection system must be incorporated in the vessel's structure for optimum safety.

1.1 History and Development

Structural fire protection is a "Life Safety system" contained in the current vessel regulations. The development of this system can be traced to casualties in the early twentieth century. The sinking of the S. S. TITANZC on April 14, 1912 heightened public concern for safety of Life at Sea, and the heavy death toll experienced in this tragedy was a primary cause for the calling of an international conference for the safety of life on the high seas. In 191t', the first International Conference on Safety of Life at sea was held in London. The recommendations of the conference concerned vessel subdivision and minimum requirements for lifesaving devices 3 however no mention was made of structural fire protection requirements. Because of the onset of world war I, the provisions of this Convention were never fully implemented.

In 1929, a second conference promoting safety of life at sea was held. The purpose of this conference was to continue development of an international standard for the safety of passenger vessels as originally begun in 1914. On May 31, 1929, the "Convention for the safety of Life at Sea" was completed. only one segment of this convention specifically addressed structural fire protection requirements. Regulation XVI required the fitting of fire-resisting bulkheads above the weather deck. The purpose of this requirement was to confine any outbreaks of fire into zones which would not exceed 40 meters in length. This figure was apparently chosen to coincide with every second watertight bulkhead. The fire-resisting bulkheads were required to be constructed of “metal or other fire-resisting materials effective to prevent for one hour, under the conditions for which the bulkheads are to be fitted in the ship, the spread of fire generating a temperature of 1500^0F at the bulkhead.”

Seven years elapsed prior to the Convention's ratification by the United States. Impetus towards the ratification of this document and the development of structural fire protection regulations occurred in 1934 when the U.S. flag passenger vessel MORRO CASTLE burned off the coast of New Jersey, causing the death of 124 persons. Public reaction to this tragedy convinced the U.S. Senate Committee on Commerce to create a special subcommittee to investigate the MORRO CASTLE tragedy and to develop recommendations for life safety standards aboard U.S. vessels. The Subcommittee was divided into groups assigned to deal separately with the various elements of life safety at sea. The investigation of fire protection measures was assigned to the Subcommittee On Fireproofing and Fire Prevention under the leadership of George G. Sharp, a prominent naval architect. In its reports the Subcommittee noted “The first problem confronting the committee was the question as to what general method of fire control might be the most practical combination of effectiveness and simplicity. past experience having demonstrated the vulnerability of complex automatic and manually controlled systems of detection and extinction. widely spaced fire doors, etc.. it was agreed that, if possible and economically practicable. the most foolproof solution to the problem would be construction of such nature that it would confine any fire to the enclosure in which it originated.” The Subcommittee had for consideration the 1929 SOLAS convention which required “fire-resisting bulkheads;" however, a precise definition or standard test for “fire-resisting bulkheads” was not included in the convention requirements.

To develop a comprehensive definition for “fire-resisting bulkheads,” the Subcommittee decided to conduct a series of full-scale shipboard fire tests to evaluate different methods of construction. A test ship, the S.S. NANTASKET, was procured from the Reserve Fleet on the James River. In mid-1936, numerous fire tests were conducted which singled out the performance of one type construction '1tili:ing steel plate and asbestos composition panels. This construction technique was recommended by the Marine Section of the National Tire Protection Association (NFPA), and included two types of “fire-resistive" bulkheads. Class A-I bulkheads, intended fat use as fire screen or main vertical :one bulkheads. and Class B bulkheads for stateroom boundaries. class A-1 bulkheads were metal bulkheads which were lined or insulated effectively to maintain structural integrity and prevent the spread of fire to the unexposed side of the test panel when subjected to a standard fire test for one hour. Class B bulkheads were incombustible materials which. could maintain structural integrity and prevent fire spread of fire to the unexposed side of the test panel when subjected to a standard fire test for thirty minutes. The standard fire test also recommended by the Marine Section of the NFPA was the laboratory fire-endurance test used by the National Bureau of Standards, which had been adopted as a standard test method in 1918 (ASTM E-119)

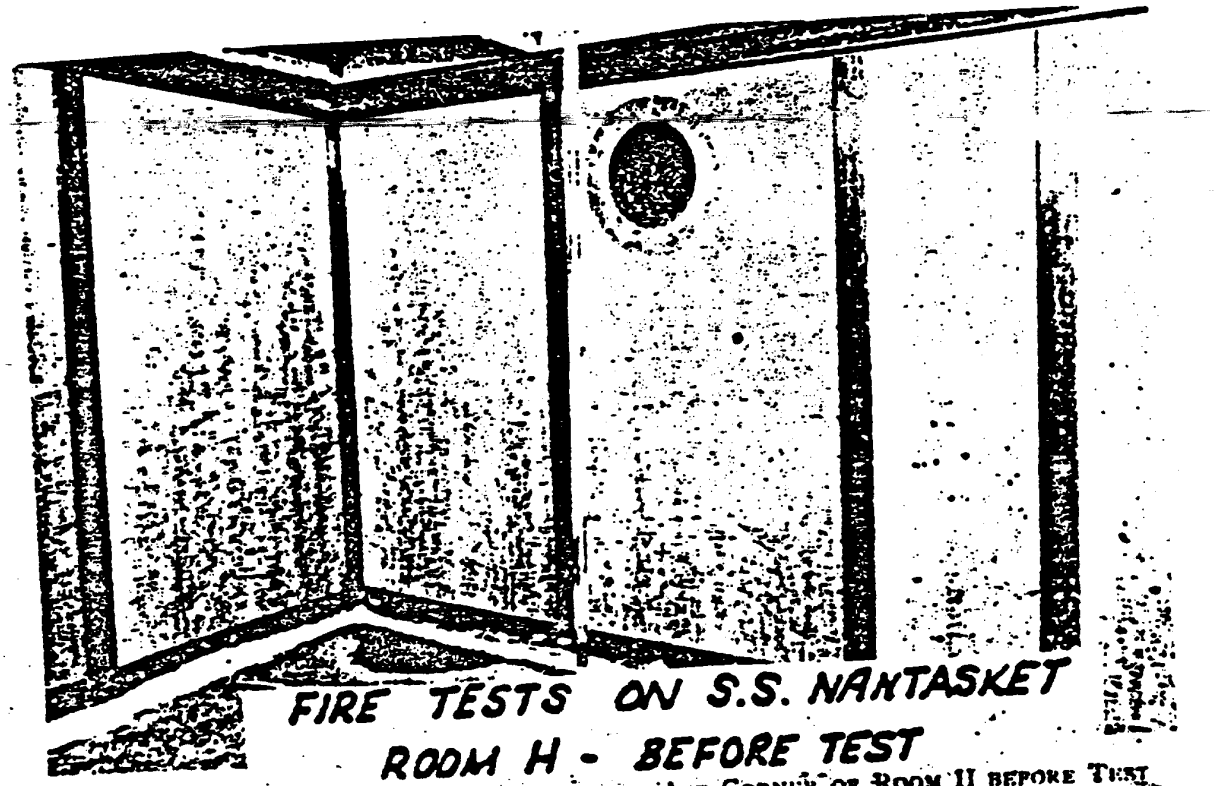
During the S.S. NANTASKET tests, temperatures were recorded to compare the flame temperature in the test rooms to the temperatures in the standard laboratory test furnance. initially, the tests were conducted using clothing and typical furnishings as a fuel source. very poor combustion occurred, and cord wood was then substituted as a fuel in the remainder of the tests. To approximate the B.T.U. content of the clothing and furnishings, a fuel load of 5 lbs/ft^2 was used. With this configuration, temperatures equivalent to those generated in the standard laboratory. test were noted.

Based upon the test results, the Subcommittee reported to Congress, “It would be impossible to fireproof a modern passenger ship by the methods used ashore." During the NANTASKET testing, it was determined that certain materials commonly used for building construction ". . . gave of f such quantities of fumes that it was found impossible to approach even a minor fire to extinguish it. During the course of experiments, a form of construction was developed in which combustible material was eliminated to such an extent that combustion cannot be sustained by any part of the ship’s structure."

As a result of the recommendations presented by the Subcommittee in Chapter IV of Senate Report No. 184, the United States Congress ratified the 1929 convention for the Safety of Life at sea, and amended the United States Code to require U.S. vessels to employ "fire-retardant material in their construction so far as is reasonable and practicable.'" Although it was not clearly defined, the type construction that was utilized in the S.S. NANTASKET tests was intended.

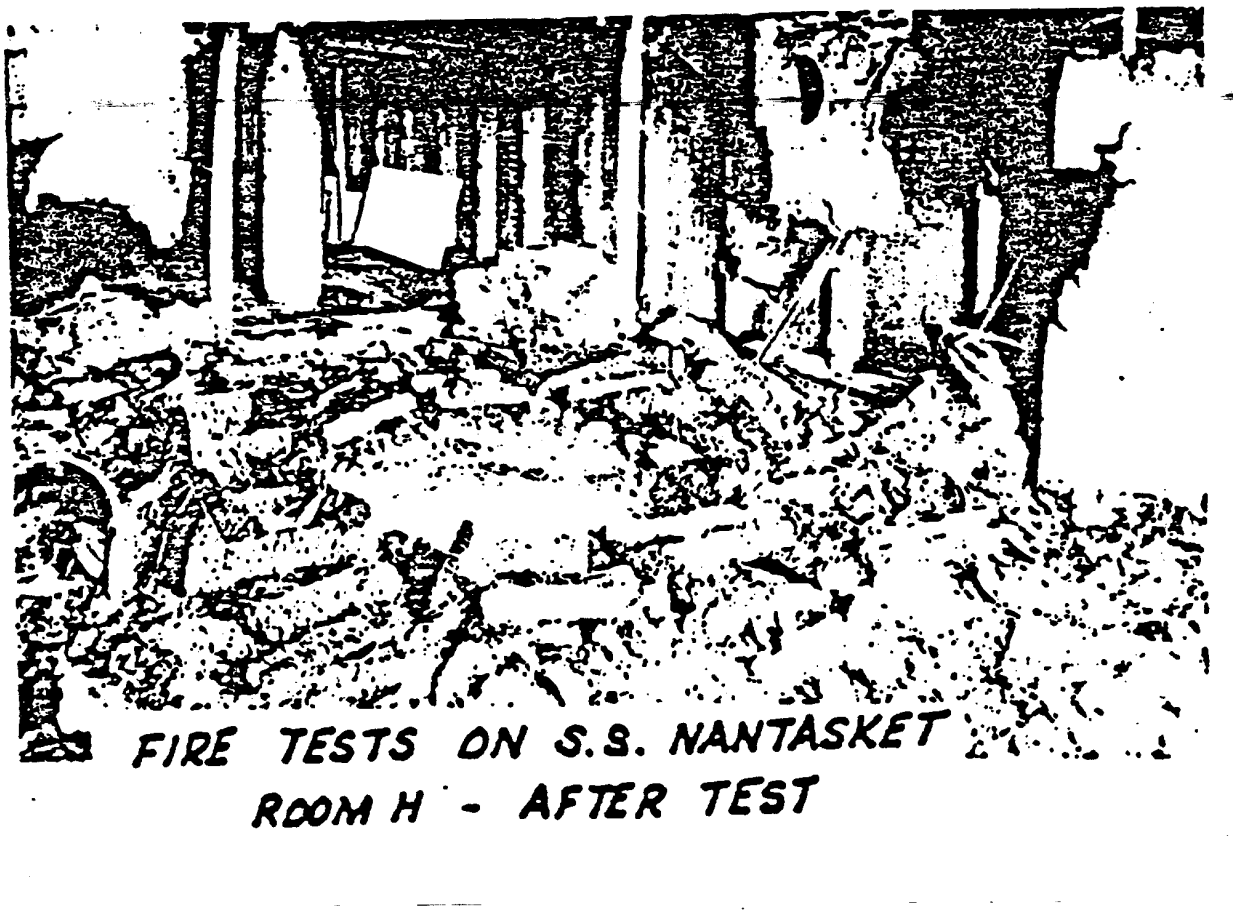
Under the authority of 46 U.S.C. 369, the Secretary of Commerce promulgated Order #42 on July 17, 1940, creating Part 144 of Title 46 of the Code of Federal Regulations (Subchapter M). paragraph 144.4 (a) of Subchapter M required interior boundaries to be "constructed of Class A-1, A, or B fire-retardant materials." Class A-1 bulkheads were required to be steel, lined or insulated with sufficient incombustible materials to prevent the average temperature on the unexposed side of the test bulkhead from rising more than 250^0F or any single point temperature from rising more than 325^0F in one hour when subjected to the standard fire test. Class A bulkheads were required to be steel and to withstand the standard fire test for one hour with no temperature rise limitations. Class B bulkheads were required to be incombustible materials capable of withstanding the standard fire test for 30 minutes and to be capable of preventing the aforementioned temperature rise limitations for 15 minutes. The terms “fire retardant” and incombustible” were used without precise definitions. Unfortunately, there were materials that could be considered fire-retardant and which, in certain configuration, could pass the standard fire test, but did not have the equivalent noncombustibility properties as steel or asbestos. Because of the lack of a specific test method, materials were approved which had the potential to greatly contribute to the fuel load of a protected space. It was not until the end of World War II that a specific test was developed to classify materials as incombustible. In 1949, the Coast Guard adopted standard 46 CFR 164.0009 for incombustible materials based upon research conducted at the National Bureau of Standards by N.P. Setchkin and S.H. Inberg.

During World War II, the need for lighter-weight ships super structured had brought about the use of aluminum bulkheads on U.S. Naval vessels. After the war, aluminum bulkheads were proposed for staterooms aboard passenger vessels. It was argued that aluminum bulkheads would be an acceptable substitute for the heavier asbestos composition panels although the aluminum panels might not withstand the standard fire test. The basis for this argument was the fact that aluminum, which has a very high thermal conductivity, will dissipate heat rapidly; secondary, it was felt that the intensity of the fires in the NANTASKET tests was due to the cord wood fuel source and, as such, did not represent actual conditions. It was maintained that the typical contents of a stateroom could not constitute a fuel load capable or producing a fire equivalent to the standard laboratory test, or even to cause melting of the bulkheads. In 1947, a full scale aluminum stateroom burnout test was conducted in conjunction with the naval architecture firm of Gibbs & Cox, inc. and the National Bureau of Standards. The stateroom test was conducted in a mock-up stateroom using passengers as a fuel source. This test verified the results of the NANTASKET tests, and showed that a fire involving only typical furnishings is capable of generating the same temperatures as the laboratory fire test furnace. The stateroom test also showed that uninsulated aluminum bulkheads cannot provide the same degree of fire protection as asbestos composition panels.



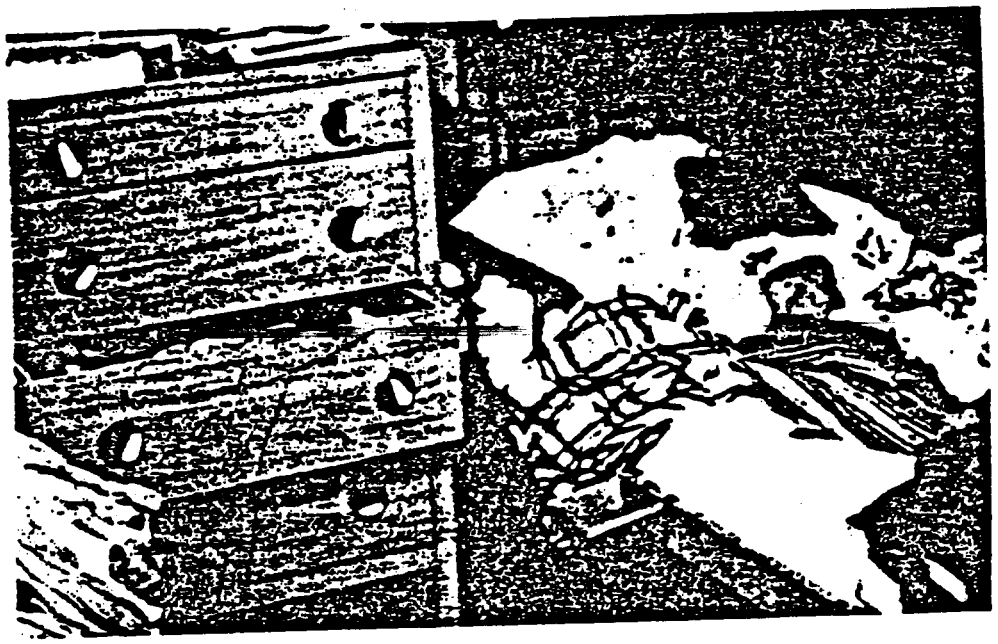
TEST NO. 3.—INTERIOR VIEW, OUTBOARD AFT CORNER OF ROOM H BEFORE TEST

1936 S.S. Nantasket Fire Tests-Room H Before Fire



1936 S.S. Nantasket Fire Tests-Room H After Fire

1947 STATEROOM FIRE TESTS



Fuel Load Consisting of Typical Furnishings

Ignition of Combustibles at Start Of Tests

The new maritime technology developed during World War II was the cause for a third international Conference on the safety of Life at sea during April of 19118, to upgrade the 1929 SOLAS convention. The United states proposed the incorporation of fire protection techniques contained in 46 CFR Subchapter M. Because the materials used for U. B. flag construction were not. available world-wide, and because several nations felt that active fire protection systems were equivalent to passive fire protection. three alternate methods of shipboard fire protection appeared in the 1948 convention. Method I was the technique proposed and employed by the United States. Method II, proposed by the United Kingdom. advocated the use of sprinklers with no restriction on the combustibility or fire endurance of compartment bulkheads. Method III, proposed by France, made use of a limited amount of fire-resisting bulkheads in conjunction with a fire detection system. The 1948 convention came into force in the united States on 19 November 1952. To implement this document. and to also revise the passenger vessel inspection regulations into one subchapter, the Coast Guard withdrew Part 144 and created a new Part 70 (Subchapter H -- passenger vessels) in Title 46 of the Code of Federal Regulations. The regulations written for this new subchapter are basically those in effect today.

In the new subchapter u changes were made regarding bulkhead fire endurance ratings. The old class A-1 bulkheads are now A-60, the Class A bulkheads were changed to A-0, and the Class 3 bulkheads are now 3-15. TWO new categories of bulkheads were created. Claus A-30 bulkheads were an intermediate Class A bulkhead. Class 3-0 bulkheads were created because the former Class 3 bulkhead panels had an inherent fifteen minute fire endurance rating; however. unless certain connector systems or .3-posts" were used. a heat transfer through the connectors occurred. It was felt that if these bulkheads with inferior connection were installed next to spaces with very low fuel loads such as toilet spaces. a B-0 rating would be acceptable.

The 1948 Convention was followed by two later conventions, SOLAS 60 and SOLAS 74, which added further improvements to international structural fire protection requirements. The present-day Coast Guard structural fire protection philosophy is based upon many full scale tests and experiences. and can be summarized by the following SOLAS principles:

(1) Division of passenger vessels into main vertical zones by thermal and 5tructural boundaries

(2) Separation of accommodation spaces from the remainder of the ship by thermal and structural boundaries;

(3) Restricted use of combustible materials;

(4) Detection of any fire aboard passenger vessels in the zone of origin;

(5) Containment and extinction of any fire in the space of origin: and

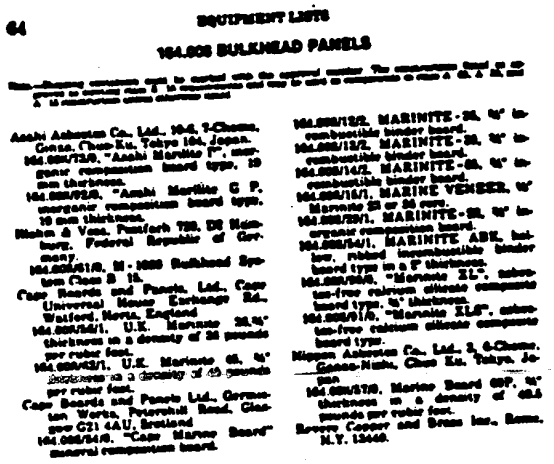
(6) protection of means of escape or access for fire fighting.

1.2 Type Approvals

All approved structural fire protection materials for use on board merchant vessels are listed in the Coast Guard's Equipment Lists, CG-190. In order for a material to be listed as "approved11. it must first be tested to the applicable Coast Guard specifications. initially, a manufacturer must apply to Commandant (G-MMT-3/TP12), 2100 2nd St. S.W., Washington. D.C. 20590, and

request approval for a specific product. Appropriate information or small samples should be included with this request so that a preliminary evaluation of the material can be made. If the material appears acceptable for testing, the manufacturer is notified of the specific test procedures and approximate costs before approval tests are conducted. Currently, the National Bureau of Standards. and Underwriters Laboratories, inc. of Northbrook, III., are Coast Guard-recognized test laboratories for testing of structural fire protection materials. After successful approval testing. the product is granted an approval number, which is listed in the Coast Guard Approved Equipment Card File, and a notice is published in the Federal Register. The card file is the most recent listing of approved materials. CG-190 is updated only periodically, and it is possible for a material to be approved and not appear in CG-190. Each Coast Guard marine safety unit has an approved equipment card file.

Materials which are required to be "fire-resistant materials" are not tested to Coast Guard specifications. but are accepted on the basis of test reports from independent testing laboratories. Approval of these materials is not done at Headquarters, but is done on a case-by-case basis by the district commander (mmt).



64 EQUIPMENT LISTS

164.005 BULKHEAD PANELS

CG-190-Coast Guard Approved Equipment Lists

ISSUED TO	UNITED STATES COAST GUARD CERTIFICATE OF APPROVAL	EXPIRATION DATE	APPROVAL NUMBER
Mt. Airy Fabric Corp. Box 1212, Stevens Penna. 17578	for Fire Retardant Fabrics	1 June 1982	164.011/34/0

DESCRIPTION

Mt. Airy Fabric Corp. drapery and seat upholstery materials described in U.S. Coast Guard test report number AD 16710 dated 1 May 1977 .

REMARKS

Plant located in East Petersburg, Penna.

IDENTIFYING DATA U.S. Coast Guard report AD 16710 dated 1 May 1977

THIS IS TO CERTIFY THAT the above named manufacturer has submitted to the undersigned satisfactory evidence that the item specified herein complies with the applicable laws and regulations as outlined on the reverse side of this Certificate, and approval is hereby given. This approval shall be in effect for a period of five years from the date hereon unless sooner canceled or suspended by proper authority.

BY DIRECTION OF THE COMMANDANT

Given Under My Hand This 1st Day of June 1977, at Washington, D. C.

Chief, Merchant Marine Technical Division, U. S. C. G.

DEPT OF TRANSP., USCG, CGHQ 16030 (Rev. 9-67)

United States Coast Guard Certificate of Approval

1.3 Definitions

Accommodation Area - A group of accommodation .paces and interconnecting corridors or spaces.

Accommodation Spaces - Those spaces including:

- Public spaces
- Halls
- Dinning Rooms
- Messrooms
- Lounges and Cafes
- Public sales rooms
- Staterooms, both passenger and crew
- Barber shops and beauty parlors
- Offices dispensaries
- Washrooms and toilet spaces
- Isolated lockers and storerooms in accommodation areas
- Isolated serving pantries in accommodation areas
- Medical treatment rooms
- Small laundries containing only tubs, washing machines, or small domestic type electric dryers
- Cleaning gear lockers

A-Class Division - A-Class divisions are bulkheads or deck. constructed of steel or equivalent metal, suitably stiffened and made intact with the main structure of the vessel. A-Class divisions are capable of preventing the passage of flame and smoke for one hour, and may include approved insulations, bulkhead panels, or deck coverings to limit the transfer of heat through the division.

A-Class Door - An A-Class door is the type door required in an division. These doors are not fire-tested, but are constructed of approved materials, arranged in a similar fashion as for A-Class divisions. A-Class doors are usually follow metal, and some types are filled with approved structural insulation. See section 2e8 below for more details.

Approved Deck covering - Materials applied on top of a deck as a finishing or leveling surface which also form a part of the deck's structural fire protection. Approved deck coverings are tested in accordance with 46 CFR 164.006. Rugs and overlays are not deck coverings. See section 2.4 for more details.

Approved 'Materials - Approved materials are those which meet the required criteria set forth in Coast Guard regulations as follows:

- Deck coverings - 46 CFR 164.006
- Structural insulations - CFR 164.007
- Bulkhead Panels - 46 CFR 164.008
- Noncombustible materials - 46 CFR 164.009
- Fabrics (Tentative) - 46 CFR 164.011
- Interior Finishes - 46 CFR 164.012

Automatic Fire Damper- A duct closure device, held open by a fusible link which melts at a pre-set temperature. After the fusible link melts, the damper automatically closes, sealing off the duct. These dampers are designed to prevent the spread of fire and smoke through ductwork and are required to be manually operable as well. Similar devices are operated by pressure switches on carbon dioxide and Nalon 1301 systems to seal of f protected spaces in order to maintain an extinguishing concentration of agent. section 3.LI contains specific details for automatic and manual fire dampers.

B-Class Division - B-Class divisions are divisions constructed of noncombustible materials and made intact from deck to deck or to a continuous B-Class ceiling on both sides, the vessel's shell, or other boundaries. They are required to prevent the passage of flame, but not smoke, for thirty. minutes.

B-Class Door - A B-Class door is the type door used in 3-Class divisions. These doors may be metal or other noncombustible material. Wire-inserted glass and vent grilles may be installed in these doors. For more information, see section 2.8.

Bulkhead Panel - Bulkhead panels are sections of noncombustible binder board which are fitted together to form a division. Where these panels are used as a B-Class division, they alone form the bulkhead. Each panel is joined to two adjacent pane 15 and to the overhead and decks with approved joiner construction.

Category A Machinery Space - A Category A machinery space is any space including trunks and ducts to such a space that contains:

(a) Internal combustion machinery used for main propulsion;

(b) Internal combustion machinery used for purposes other than main propulsion where the total aggregate power is at least 500 brake horsepower (373 k.w.);

(c) Internal combustion machinery that uses a fuel that has a flash point of less than 43.3^0C (110^0F); or

(d) One or more oil fired boilers or oil fuel units.

C-Class Divisions - C-Class divisions are bulkheads or decks, constructed of noncombustible materials, which meet no requirements relative to the passage of flame nor the limiting of temperature rise. Aboard tank vessels and cargo vessels, C-Class divisions may be used for stateroom boundaries which do not form corridors.

C-Class Door - A C-Class door is the type door installed in a C-Class division. These doors must be constructed of non-combustible materials.

Cargo Space - Those spaces including:

- Cargo Holds
- Lockers
- Refrigerated Cargo spaces
- Cargo Oil Tanks
- All trunks leading to and from the above listed spaces.

Ceiling - A ceiling is a horizontal division within a space for the purposes of decoration, acoustics, or fire protection. A ceiling is not considered part of the overhead structural deck. ceilings are constructed of non-combustible materials. combustible moldings, veneers, or trims may not extend into the hidden space above the ceiling

Combustible Material - Any material which fails the noncombustibility test for materials on board merchant vessels as set forth in 46 CFR 164.009.

Continuous B-Class Ceiling - This is a ceiling which forms a, structural fire protection element between two decks. A continuous B-Class ceiling is used in lieu of extending B-Class bulkheads from deck to deck in accommodation and service areas. These ceilings are tested to46 CFR 164.008 requirements in addition to being non-combustible.

Control Station - control stations are those spaces including:

- spaces containing the emergency source of power
- spaces where, a continuous watch is maintained and where navigating and radio equipment is located
- spaces where fire control equipment is centralized such as CO_2 rooms.

Note: Machinery space engineering control stations are not included in this definition..

Dead End Corridor - A dead end corridor is a passageway from which there is only one route of escape. see section 3.3 for additional information.

Deck - A deck is a horizontal division in a vessel's structure. Decks in certain areas provide structural fire protection. see section 3.2 for a more complete discussion.

Draft Stop - A draft stop is a division or “curtain” installed between ceilings or linings and the vessel's structure. The purpose of a draft stop is to prevent the spread of fire and smoke in concealed spaces. See section 3.1 for additional information.

Exit -A means of egress from a space. It can be a door or a corridor leading to a door or another space with a door, etc.

Fire-Resistant - A descriptive term applied only to shipboard materials such as fabrics, paddings, and draperies. It denotes a considerably lower degree of fire protection than non-combustible, yet maintains a degree of protection higher than that of ordinary combustible materials used aboard vessels. The intent of specifying fire-resistant furnishings is to provide materials with a lower probability of ignition and flame propagation. It should be noted that this term does not, in all cases, denote the identical degree of fire protection used in building construction. See section 2.6 for additional information.

Furnishings - Furnishings are the contents of rooms, such as desks, chairs, tables, dressers, sofas, draperies, rugs, etc. See section 2.6 for additional information.

Incombustible - See non-combustible.

Incombustible veneers and trim - Materials which are approved under 46 CFR 164.012 or 46 CFR 164.009.

Integrity - The basic, fire-resisting ability of a division. For example; to maintain the integrity of a bulkhead, openings cut for the passage of electrical cables must be 8ealed to prevent the transmission of heat and smoke.

Interior Finish - An interior finish is any coating or veneer applied as a finish to an approved bulkhead panel. non-combustible material, or structural insulation on a bulkhead or ceiling. This includes the visible finish. all intermediate materials. and all application materials. adhesives, etc.

Joiner Construction - Joiner finished interior of compartments. The main structure of a vessel is subdivided by joiner work to form livable, workable, and decorative spaces Bulkhead panels, ceilings and connectors (a joiner system) are the components of joiner construction.

Machinery spaces - Machinery spaces are those spaces including:

- Category A machinery spaces
- spaces containing propelling machinery
- Poiler spaces
- spaces containing fuel oil units, steam, or internal combustion machinery
- spaces containing generators or electrical motors and auxiliaries (NOTE: spaces containing the emergency source of power are considered control stations).
- oil filling stations
- spaces containing refrigeration machinery
- spaces containing ventilation and air conditioning machinery
- All trunks leading to and from the above listed spaces.

Main Vertical Zone - Main vertical zones are sections of a vessel the mean lengths of which do not exceed 131 ft (40 m) The hull, superstructure, and deckhouse of passenger vessels are required to be divided into main vertical zones by steel or equivalent metal bulkheads or decks to prevent the spread of fire throughout the vessel. Main vertical zone divisions also contain a fire to permit attempts at extinguishment.

This requirement was originally derived from the 1929 SOLAS convention.

Main Vertical Zone Bulkhead/Deck - These are at least A-Class divisions that separate one main vertical zone from an adjacent main vertical zone.

Means of Escape - A means of escape is a route by which persons may evacuate a space to an area of refuge, such as the lifeboat embarkation area. Exits are a portion of a required means of escape.

Miscellaneous Spaces - Miscellaneous spaces include:

- Fuel and water tanks
- Voids
- Open decks and enclosed promenades. except in way of lifeboat embarkation and lowering areas
- Shaft alleys. when separated from machinery spaces and containing no combustible materials.

Non-combustible Material - Any material approved by the Coast Guard as having successfully passed the non-combustibility test in 46 CFR 164.009. certain materials are considered non-

combustible without testing. See section 2.1 for additional information. NOTE: The word “non-combustible" replaces the term “incombustible."

Overlays - overlays are materials such as wood, and vinyl tiles which are applied to decks for finishing purposes. Within accommodation and service areas, overlays less -than an average 3/8 of an inch (9.5 mm) in thickness need not meet any requirements for combustibility.

Passageways - A passageway is a corridor. Aboard passenger vessels, corridors or passageways over eight feet in width are considered public spaces.

Penetration - A penetration is any opening made in a bulkhead or deck to permit the passage of piping. wiring, remote control shafts, or ventilation ducts. For the purposes of structural fire protection. these openings must be protected to maintain the integrity of the division. see section 2.7 for additional specific information.

Public Spaces - public spaces are spaces aboard passenger vessels including:

- Halls
- Dining rooms
- Lunges
- Cafes
- Other similar spaces accessible to passengers Safety Areas - safety areas aboard passenger vessels include:
- Control stations, including spaces containing the emergency source of power, spaces containing navigating and radio equipment, and spaces where fire control equipment is centralized.
- Stairways and elevator enclosures
- Corridors
- Open decks and enclosed promenades in way of lifeboat embarkation areas.

Service Spaces - Service spaces include:

- Motion picture projection rooms
- Film stowage rooms
- Galleys
- Main pantries and storerooms (including connecting alleyways and stairs)
- Diet kitchens
- Workshops (not part of machinery spaces)
- Large laundries and drying rooms
- Mail and baggage rooms
- Garbage and trash disposal and stowage rooms
- Paint and lamp rooms

Stairtower - A stair tower is a group of stairways enclosed' in a continuous vertical A-Class trunk with self-closing A-Class doors at every level. A stairway is not a stairtower.

Stairway - A stairway is a vertical means of escape between two decks. A stairway does not penetrate mare than one deck. ~ stairway which penetrates only one deck must be enclosed by

bulkheads and a door at least at one level. If it is necessary to have a stairway that penetrates more than one deck, a- stairtower is provided.

Standard Tire Test - A "standard fire test" is one in which a specimen is exposed in a test furnace to temperatures corresponding to the standard time-temperature curve. The specimen resembles, as closely as possible the intended construction and includes, where appropriate, at least one joint. The standard time-temperature curve is defined by a smooth curve drawn through the following points, starting at ambient temperature:

- At the end of 5 minutes - 538^0 ($1{,}0000F^0$);
- At the end of 10 minutes - 704^0C ($1{,}300^0$F);
- At the end of 30 minutes - 843^0C ($1{,}550^0$F);
- At the end of 60 minutes - 927^0C ($1{,}700^0$F);

"Steel Or Other Equivalent Metal" - Where the term "steel or other equivalent metal" is used in this guide, it is intended to mean a material which, by itself or Cue to insulation provided, has structural and fire-en durance properties equivalent to steel at the end of the standard fire test.

Stepped Main Vertical Zone - Where the main vertical zone on one deck is several feet fore or aft of the main vertical zone above or below it. The main vertical zone is "stepped", and the deck area between the two main vertical zones must generally be of a higher class fire endurance (i.e., A-60, A-30, etc.). This is done to insure structural integrity and to prevent the spread of flame and smoke from one main vertical zone to another.

Structural Fire protection - structural fire protection is a means of minimizing the probability of a major fire occurrence and life loss by designing structural elements to confine any outbreaks of fire to as small an area as possible. This is accomplished by specifying fire endurance capabilities of structural elements. Additional items considered are joinerwork details and penetrations of structural elements. Structural or fire insulation refers to insulation employed as a part of the structural fire protection system.

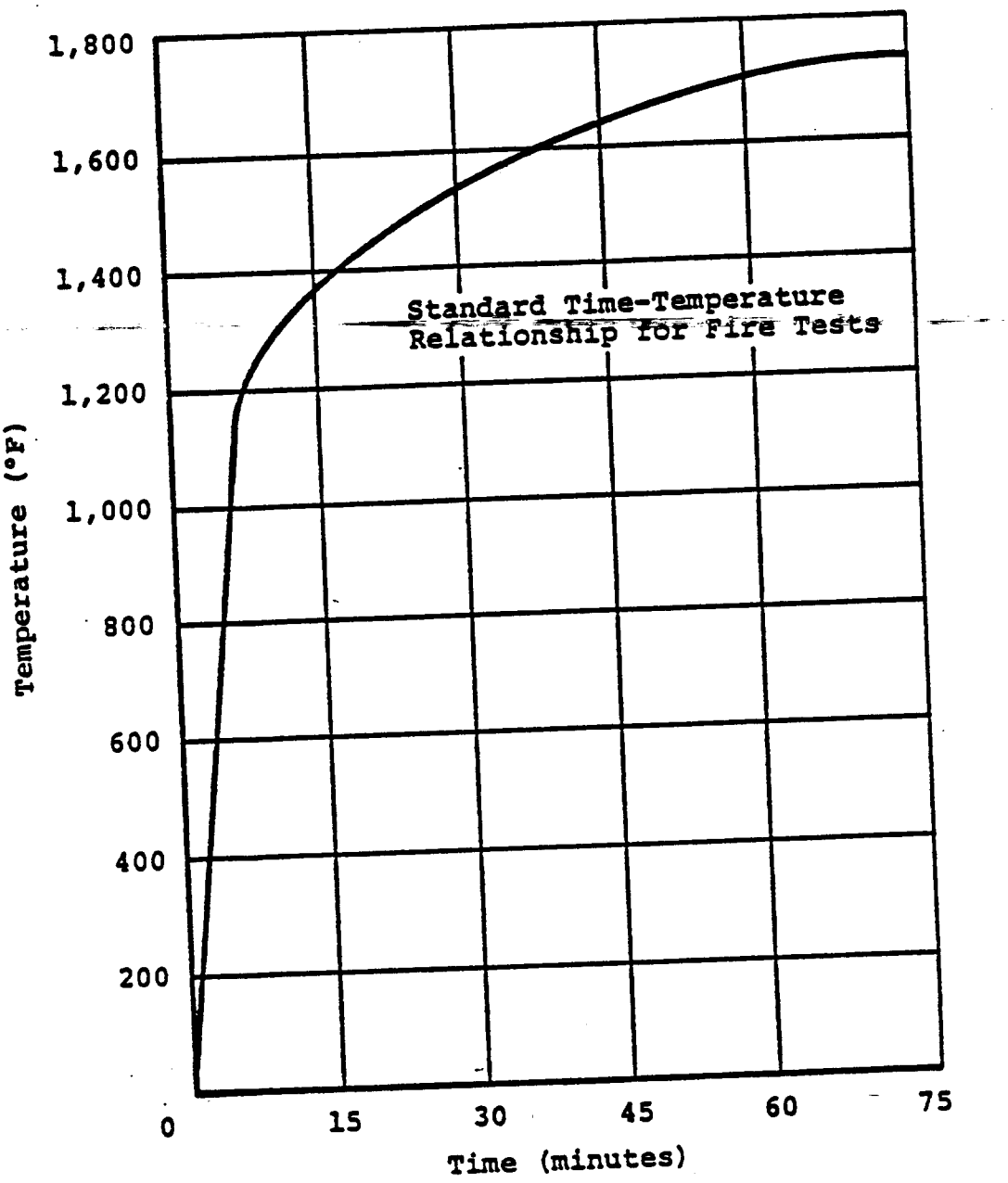
Trunk - Generally, a trunk is a vertical shaft or duct for the passage of pipes, wires. or other devices.

U.L. -The letters "U.L." stands for Underwriters Laboratories, Inc., a not-for-profit independent testing laboratory located in Northbrook, III.

Wire-Inserted Glass - wire-inserted glass is a special type of glass with reinforcing wires cast into the glass. Wire-inserted glass provides more fire endurance than ordinary or tempered window glass. See section 2.8 for additional specific information.

1.4 Submittal of Plans For Approval

For all new construction or major rebuilding, structural fire protection plans should be submitted to the Coast Guard district commander (mmt) reviewing the vessel. The completeness of this plan submittal will greatly aid in timely approval. The submittal should include the following plans:



STANDARD FIRE TEST-Time vs Temperature Control Curve

(1) General Arrangement - This drawing should clearly show the arrangement and type of each space, including the available means of escape. It is important that each space is labeled and bulkhead and deck insulation values noted. The symbols used to note insulation values should be easily distinguishable.

(2) List of Materials - This list should clearly identify all deck coverings, overlays, rugs, carpets, under pads, bulkhead panels, structural insulations, and interior finish materials. The manufacturer and Coast Guard approval number (if applicable) should be indicated for each item.

(3) Ventilation system - This plan should note the general arrangement of all duct work. It should also include the material. and thickness of each duct, and fire damper details and locations.

(4) Joinerwork Details - This plan should show typical bulkhead and ceiling installation details. Section 3.1 contains recommended details for this drawing.

(5) Penetration Details - This plan should show typical penetrations of A-Class bulkheads and decks. It should include piping, wiring, and ventilation details, including material.

2.0 Materials of Construction

2.1 Non-combustible Materials

One of the basic principles of the Coast Guard' 5 structural fire protection philosophy is that the materials from which the vessel and its subdivisions are constructed should not add to the fuel load available for combustion. This requires that the majority of materials of construction within accommodation and service areas be non-combustible. A standard non-combustibility test was developed by the Coast Guard in 1949 as 46 CFR 164.009. This test has remained basically unaltered, except for a recent revision which implemented XMCO Resolution A.270 (VIII). This amendment changed some of the conditions of acceptance for the test data, as well as the configuration of the specimen holder and minor modifications to the furnace.

All materials required to be non-combustible must successfully pass this test except far certain materials which are known to be inherently non-combustible. The following materials came under this consideration, and no certificates of approval are issued for them:

(1) Sheet glass. block glass, clay. ceramics. and uncoated glass fibers.

(2) All metals except magnesium and magnesium allays.

(3) Portland cement, gypsum, and magnesite concretes baling aggregate of sand, gravel. asbestos fibers, expanded vermiculite, expanded or vesicular slags, diatomaceous silica, perlite. or pumice.

(4) When, knitted, or needle punched glass fabric containing not more than 2.5 percent lubricant. (These materials are accepted on the basis of manufacturer's data sheets. Laboratory test reports are not required.)

The non-combustibility test is performed On a much smaller scale than the tests for bulkhead panels or structural insulations. Five cylindrical specimens of approximate dimensions of 45 mm in diameter by 50 mm in height are individually inserted into the test furnace which has been pre-heated to $750^0 \pm 10^0$C. To be considered acceptable, the average temperature measured inside the

furnace must not rise more than 50^0C above the stabilized furnace temperature. Additionally, the observed duration of flaming of each specimen cannot exceed 10 seconds, and the average weight loss cannot exceed 50% of the pre-test weight.

2.2 structural Tnsulations

The basic element of' bulkhead and deck construction is steel plate. Coast Guard experience has shown that steel plate of 11 USSG thickness (.1196 in) or thicker has an inherent fire endurance of at least one hour, and that steel plate of 16 USSG thickness (.0598 in) or thicker has an inherent fire endurance of at least thirty minutes. Without additional insulation, plates of this thickness could be classified as A-0 and 3-0 Class divisions, respectively. Fire endurance, however, is not the sole parameter upon which the structural fire protection system is dependent. To prevent the spread of fire by radiant or conducted heat, some structural divisions must also act as insulators to prevent the transmission of heat to the unexposed side of the bulkhead or deck.

There are basically three ways to achieve this insulating capability on bare steel:

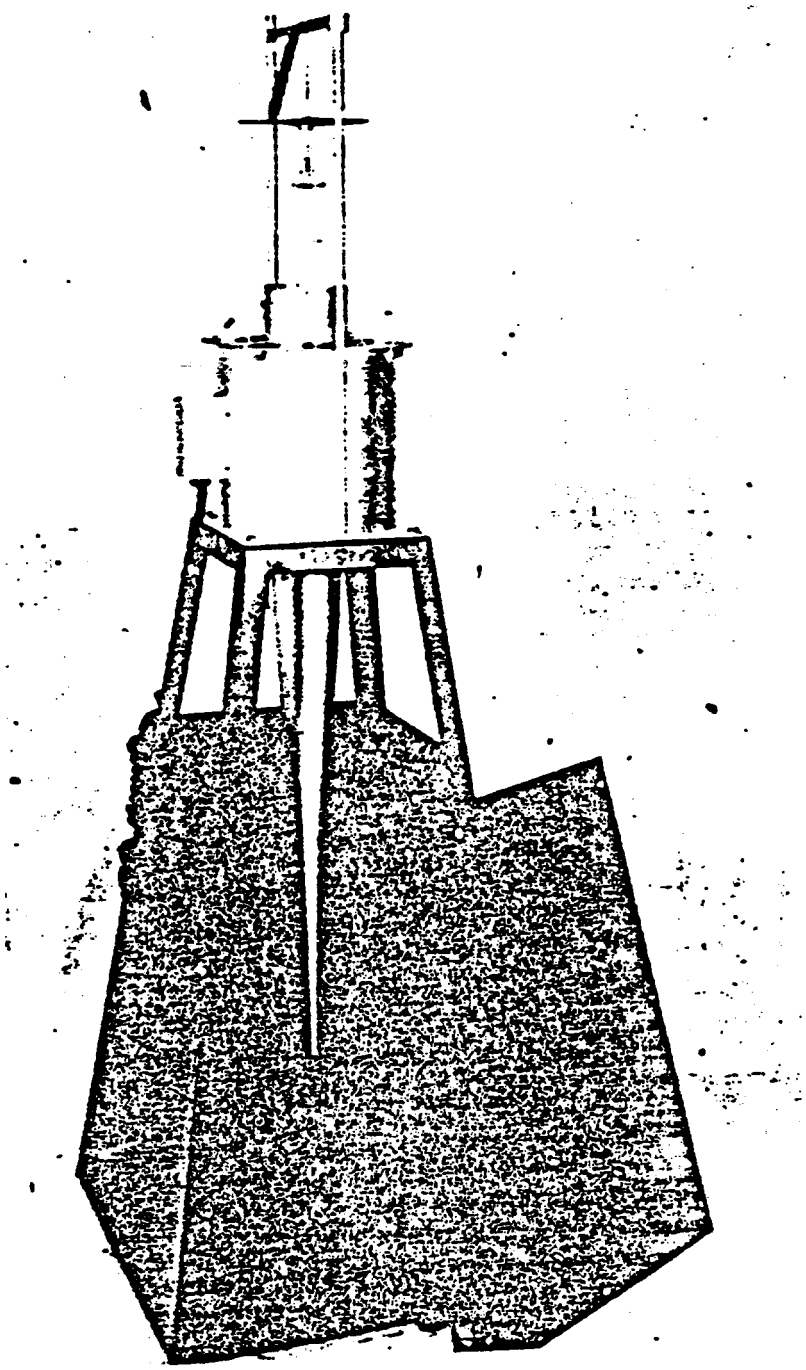
(1) Application of approved structural insulation,
(2) Application of approved bulkhead panels, and
(3) Arrangement of components.

Since the performance of the steel plate has been proven, all that generally needs evaluation are the thermal insulation properties of the structural insulation and bulkhead panels.

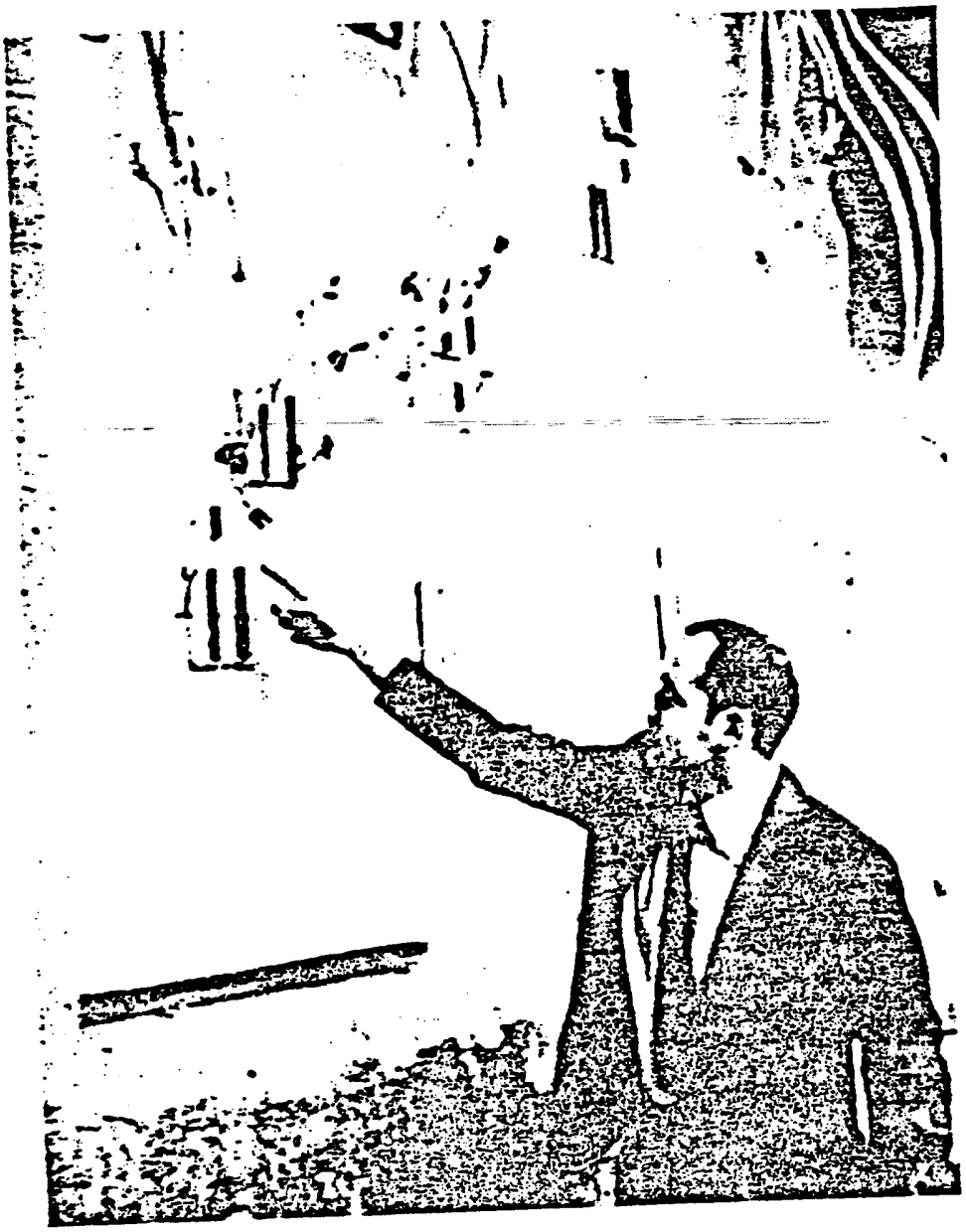
structural insulations are tested to a standard Coast Guard fire test described in 46 CFR 164.007. This test is a furnace test designed to measure only the insulating value of the structural insulation, and not the structural integrity of the assemblies. The basic test procedure requires the mounting of an insulation specimen (minimum dimensions of 40" x 60") on a 3/16 inch thick steel plate. This assembly is then exposed to the standard test furnace. The steel plate is the unexposed side of the assembly from which the temperature rise measurements are taken. To pass the test, the maximum temperature rise at the end of one hour cannot be more than 325^0F (180^0C) above ambient temperature at any one point, and the average temperature rise above ambient temperature of all the test thermocouples must not exceed 250^0F (139^0C).

2.3 Bulkhead Panels

Generally, bulkhead panels are '1 foot by B foot panels of non-combustible binder board. They are tested to the specifications in 46 CFR 164.009. This test is also a furnace test, designed to simulate the identical exposure to the test panel and its joinerwork system as a shipboard stateroom fire. Bulkhead panels are used as B-Class divisions or as components in ~-Class divisions. To be used as a component in A-60 Class construction, the test panel must maintain its integrity during the test for 60 minutes. Bulkhead panels which only remain intact for 30 minutes can only be used in A-30 or A-15 class construction. In all cases except for a 3-0 Class rating, the test panel must meet the thermal insulation requirements for limiting temperature rise for a minimum of 15 minutes. A primary requirement for bath structural insulations and bulkhead panels is that both of these materials must qualify as approved non-combustible materials (~6 CFR 164.009) prior to testing.



Noncombustible Materials Test Furnace



Test Furnace for Bulkhead Panels and Structural Insulations. Note Thermocouple Locations.

2.4 Deck Coverings

Unlike structural insulations and bulkhead panels, deck coverings are not required to pass the non-combustibility test in 46 CFR 164.009, although such materials may be used as deck coverings.

The Coast Guard previously accepted magnesite type deck coverings for use aboard merchant vessels before the S.S NANTASKET tests in 1936. During the test series. several configurations of standard deck coverings were tested. and the conclusion made that the type deck coverings used in general practice would be adequate. Because of uncertainty regarding new type deck coverings, it was determined that unless the organic carbon content of the composite was limited, a potential hazard could exist. Therefore, deck coverings were limited to incombustible materials (which at that time were not subject to test) such as magnesium oxychloride cements. In answer to industry requests, a test method was later developed to evaluate deck coverings containing a minimal organic content. 46 CFR 164.006, implemented in 1953, permits a maximum organic carbon content of .12 grams/cubic centimeter. This test method also contains a smoke production test. The implementation of the new passenger vessel regulations in 1953 required that some method also be available for determining the fire endurance of decks. 46 CFR 164.006 therefore includes a requirement that a 12 inch by 27 inch specimen be exposed to a standard fire endurance test.

2.5 Interior Finish

The interior finish applied to shipboard compartments is important because the spread of flame and the generation of smoke or other toxic gases is initially dependent upon the properties of the interior finish materials. Approved interior finish materials are tested in accordance with LI6 CEP 164.012. Table 2.5 lists the requirements for interior finish materials within accommodations and service areas. The maximum permitted thickness of these materials is .075 inches. If a thicker finish is desired, the use of any material approved in accordance with 46 CPR 164.009 is acceptable. In the event that paint is used as the finish, the regulations permit a reasonable number of coats of paint. It should be noted that a specific paint thickness has not been specified. This permits evaluation on an individual basis.

Materials approved under 46 C.TR 164.012 are tested to A standard E-84. Approved materials must have a flame spread of 20 or less and a smoke developed rating of 10 or less. !f an interior finish material is mounted with an adhesive, the test specimen must be mounted in the furnace with the adhesive recommended by the manufacturer. The approval of the interior finish is then valid only if installed with the adhesive used -in the test. The adhesive is noted on the material's approval card. Materials not approved under 46 CFR 164.012, but tested to ASTM standard E-84, can be accepted on a case-by-case basis if the appropriate U.L. reports are furnished to Commandant (G-MMT-3) which certify that the material was tested in a configuration .075" thick or less and has an acceptable flame spread and smoke-developed rating.

The interior finish requirements in the regulations, which are tabulated in table 2.5, apply to all surfaces on bulkheads and ceilings, but not decks. ceiling light diffusers are also considered subject to these requirements; however, an exemption has been permitted to allow plastic diffusers if enclosed in a metal light fixture, and if the total surface of the light diffusers does not exceed 35% of the ceiling area in any space. When installed in stairways, corridors, and control stations, this percentage should not exceed 25% of the total ceiling area.

2.6 Furniture and Furnishings

Room furnishings are an additional subject requiring consideration with respect to shipboard fire protection. In the design and approval of a vessel, attempts are made to minimize the amount of combustible materials contained in the accommodations and service area structure, thereby minimizing the fuel load contribution of bulkheads and decks. similarly, the contents of each space constitute part of the fuel load. Aboard cargo and tank vessels, this factor is not as critical as aboard passenger vessels due to additional amounts of passenger belongings and decor.

It has been the philosophy of the Coast Guard to design the structural fire protection regulations for shipboard spaces based upon a fuel load of 10 lb/ft^3, except for spaces containing fire-resistant furnishings. (A ten pound per square foot fuel load is roughly equivalent to a fire of 60 minutes duration.) This ten pound limit is intended to include 2.5 pounds for personal affects and 7.5 pounds for combustible furniture, furnishings, trig', drapes. And interior finish materials. Normally, calculations to determine this value are performed only if during plan reviewed it appears that the addition of fiberglass shower modules, or large amounts of combustible synthetic materials. will cause the fuel load to exceed this limit.

Aboard passenger vessels. “fire-resistant furnishings" may be used in order to utilize bulkheads and decks of a reduced insulating value, £16 CYR 72.05-10 contains tables which specify minimum requirements for bulkheads and decks. staterooms containing fire resistant furnishings' are considered type 5 spaces instead of type 6 spaces. It should be noted that where the regulations require “incombustible veneers and trim", the use of materials which are approved under 46 CFR 164.012 is acceptable.

"Fire resistant furnishings" are defined in 46 CFR 72.05-55. case furniture is required to be constructed entirely of non-combustible materials with an allowance for a 1/8” veneer of any material as the top surface. Free-standing furniture such as chairs, tables, or sofas must have frames of non-combustible materials. The frame is generally defined as the components which provide structural support. The original type chairs envisioned by the regulations consisted of a steel frame with a bottom cushion and back cushion. The materials forming the cushion could be combustible, e.g., plywood or fiberglass. contemporary furniture designs provide seating which is of modular or wrap-around construction. Chairs of this sort consist of a molded plastic or fiberglass back and bottom which is supported by a steel base. Furniture of such design does not comply with the intent of the requirement for a non-combustible frame because the molded plastic is the structural support for the back cushion. In any case, what must be considered is the total quantity of combustible materials in the seating design. When alternative designs are available, the design with the lower quantity of combustibles should be favored, regardless of frame design.

Fire-resistant draperies should be tested in accordance with tentative Coast Guard specification 46 CFR 164.011. Inasmuch as this standard is not a widely accepted standard, fabrics which have been tested to both the large and small scale tests of NFPA standard 701 will also be considered acceptable. Fabrics used on furniture intended for use in stairways and corridors of passenger vessels must also meet this standard; The padding materials used for this furniture must be "fire-resistant". Foam or other plastic paddings are considered fire-resistant if rated "self-extinguishing", or if they have a maximum extent of burning less than 122m (5 in) when tested in accordance with ASTM specification D-1692.

Table 2.5

Interior Finish Requirements

	Stairways & Corridors	Hidden Spaces	Any other bulkhead within Accommodation & Service Spaces
Tank Vessels	164.012 Material (0.75" max.)	164.012 Material (.077" max.)	Any material (.079" or 2mm max.)
Cargo Vessels	164.012 Material (.075" max.)	164.012 Material .075" max.)	Any material (2/28" max.)
Passenger Vessels	164.012 Material (.075" max.)	164.012 Material (.075" max.)	Any material (2/28" max.)*
Mobile Offshore Drilling Units	164.012 Material (.075" max.)	164.012 Material (.075" max.)	Any material (2.1mm or .083" max.)

*The total volume of combustible trim materials must not exceed an equivalent 1/10" veneer on the combined bulkhead area of each compartment.

NOTE: ASTM D-1692 no longer uses the terms "non-burning" or “self-extinguishing" because of a Federal Trade Commission (FTC) Consent Order prohibiting the use of these and similar terms that may be improperly used. ASTM D-1692 is a small scale test that has been used to eliminate the most combustible foam plastics from shipboard use. In the original test, a 2" by 6" by ½” or less sample resting horizontally on a ¼” mesh screen was exposed at one end by a fan-shaped bunsen burner flame. The flame was removed after one minute. If the sample did not ignite, it was termed "non-burning." If the sample did ignite but burned less than 5 inches, it was termed “self-extinguishing." These terms have no relationship to the traditional connotation of “non-burning" and “self-extinguishing" since they do not predict the behavior of the specimens in a real fire. However, the test does predict the ease with which a small ignition source such as a match or cigarette will cause a self-propagating fire. Therefore, ASTM D-1692 is still used by the Coast Guard as a means of eliminating the most combustible foam plastics from certain uses on vessels.

2.7 Penetrations

As previously. discussed, bulkheads and decks are designed to varying fire endurance-requirements depending upon their location within the vessel. However, once installed, they are almost always breached to allow piping, wiring, or ventilation ducting to pass through. In order to maintain an effective boundary, penetrations must be properly sealed to maintain a degree of fire endurance which is equivalent to the structural member they pierce. Due to the varying nature of protection necessary for these penetrations, each type will be dealt with separately.

Piping

As required by 46 CFR 56.01-10(d), typical bulkhead and deck penetration details must be submitted for approval. The basic design criteria for piping penetrations is contained in 46 CFR 56.50-1(a). Lead or other heat-sensitive materials (those with melting points below 1700^0F) may not be used for sealing penetrations in A-Class or steel B-Class fire boundaries. Additionally, pipe flanges may not be bolted to bulkheads to form a joint. To permit design flexibility, piping penetrations are not type approved. Final approval is generally based upon good marine practice in design and installation. For example; whenever ferrous pipe penetrates a steel bulkhead at deck, the opening around the pipe could be sealed by a tight fitting steel sleeve or alternatively, the opening could be welded. Figures 2.7.1 through 2.7.3 show typical acceptable configurations. In the event that a 3-Class bulkhead panel is penetrated, the -opening around the pipe should be kept to a maximum of 1/16 inch.

Whenever non-ferrous pipe such as aluminum, PVC, or copper alloy penetrates a steel A-0 Class division, the non-ferrous pipe must not penetrate the division, but must connect to a steel spoolpiece with an acceptable shutoff valve installed in the bulkhead.

It should be noted that shut-off valves are not permitted in vent, overflow, exhaust. or relief valve and safety valve discharge piping. In the event that any of these pipes must penetrate an A-Class boundary, they would be required to be steel or equivalent materials.

Piping penetrations through insulated steel divisions are treated as above. Additionally, structural insulation approved under 46 CER 164.007 must be applied to the piping for at least 12 inches on the insulated side of the division. The thickness of insulation applied to the pipe must be the same as the division penetrated.

Wiring

46 CPF. 111.60 requires that whenever a cable penetrates a steel bulkhead or deck, a minimum bearing surface of 114 inch must be provided. Normally, A- end 3-Class steel bulkheads are less than 114 inch in thickness, therefore an additional bearing surface is required. The generally accepted marine practice is to use steel or other ferrous stuffing tubes, figure 2.7.4. specific approval of stuffing tubes is not granted, however. they are evaluated for suitability during plan review at the Coast Guard district offices. If it is necessary to group together several cables for penetration of a division, an alternative to stuffing tubes is available in the form of multiple cable penetration devices. These devices are specifically approved by the Commandant for use in A-0 Class divisions. Approved multiple cable penetration devices and methods are listed in CG-293, Miscellaneous Electrical Equipment List.

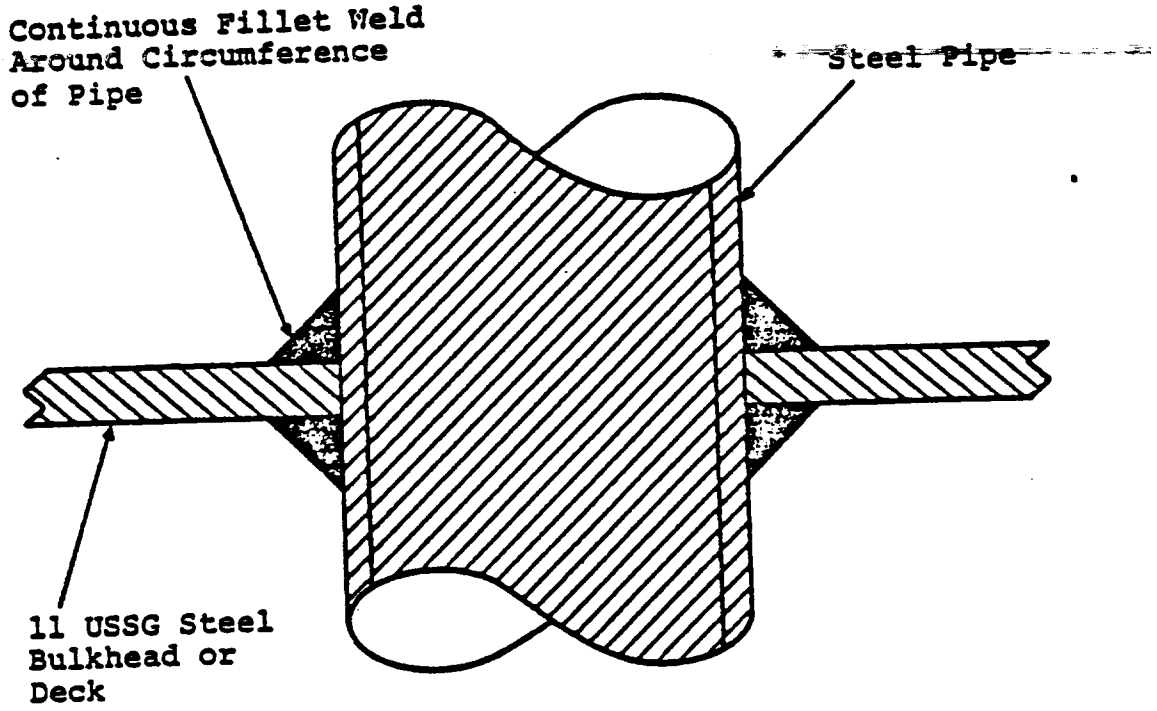
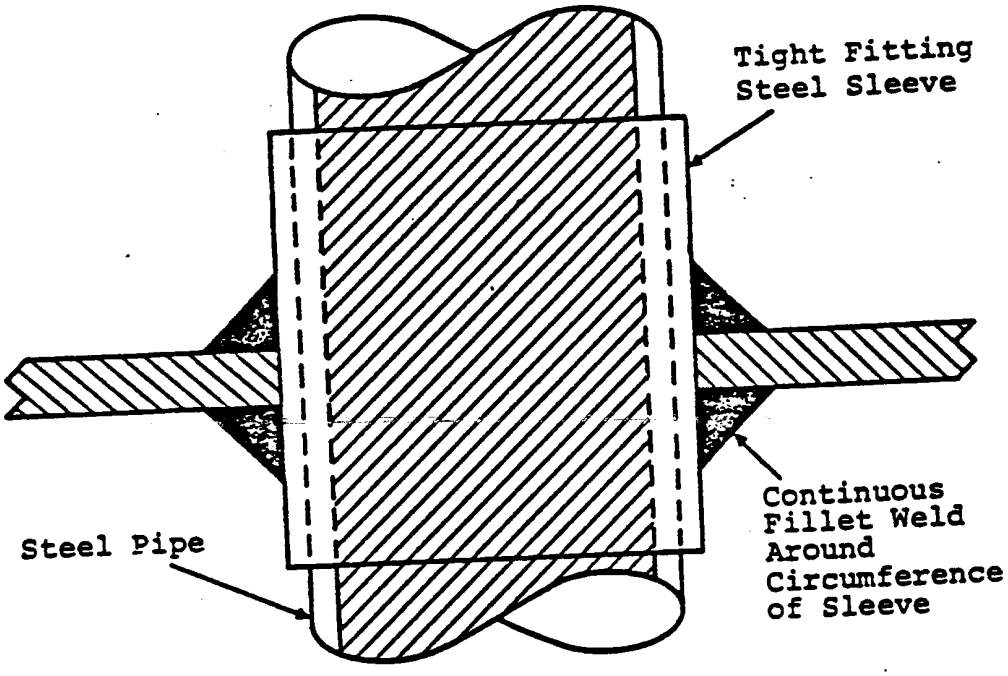


Figure 2.7.1-Typical Piping Penetration of A-Class Division



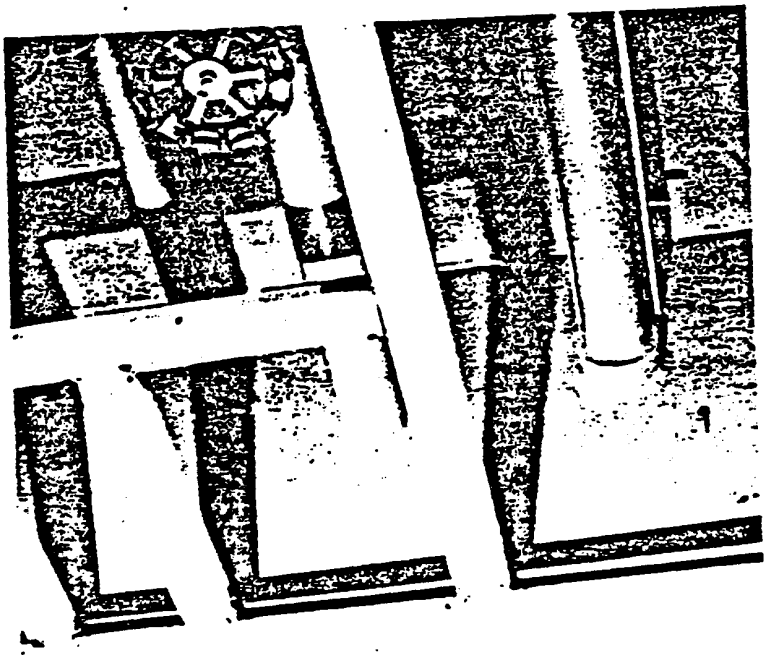
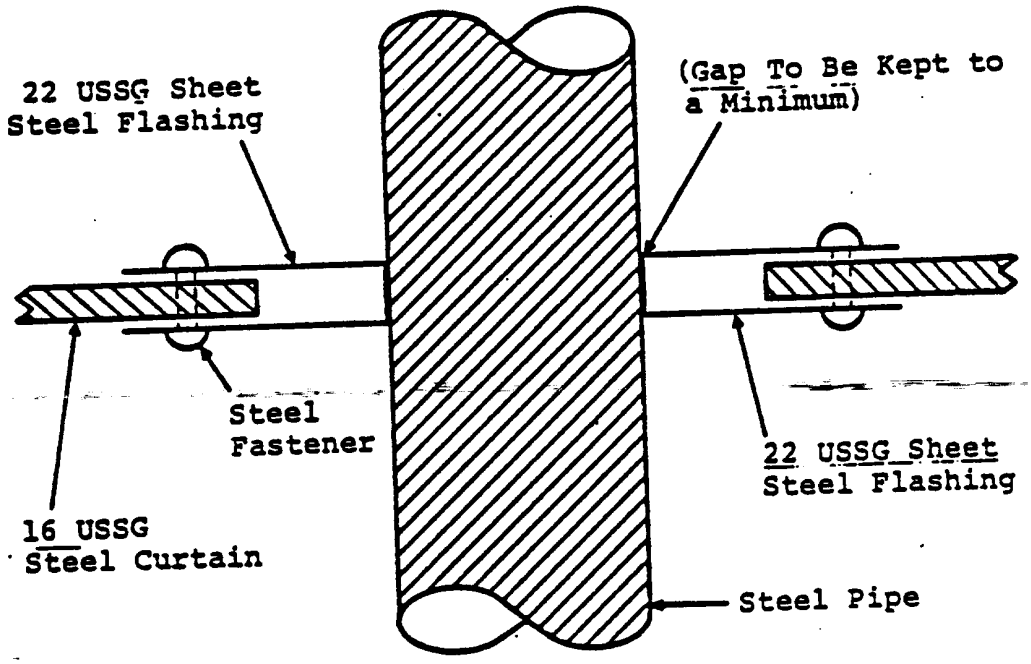


Figure 2.7.2-Typical Piping Penetration of A-Class Division Using Steel Sleeve Around Pipe



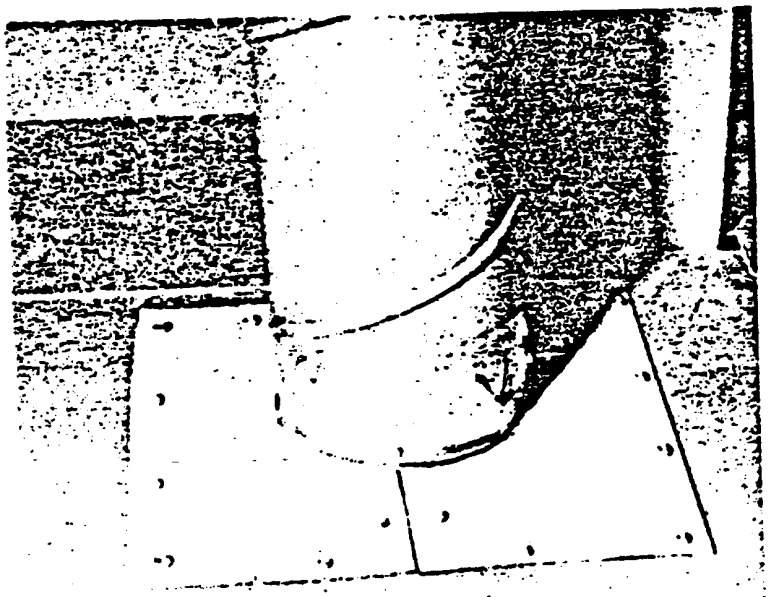


Figure 2.7.3-Typical Piping Penetration in Steel B-Class Corridor Bulkhead

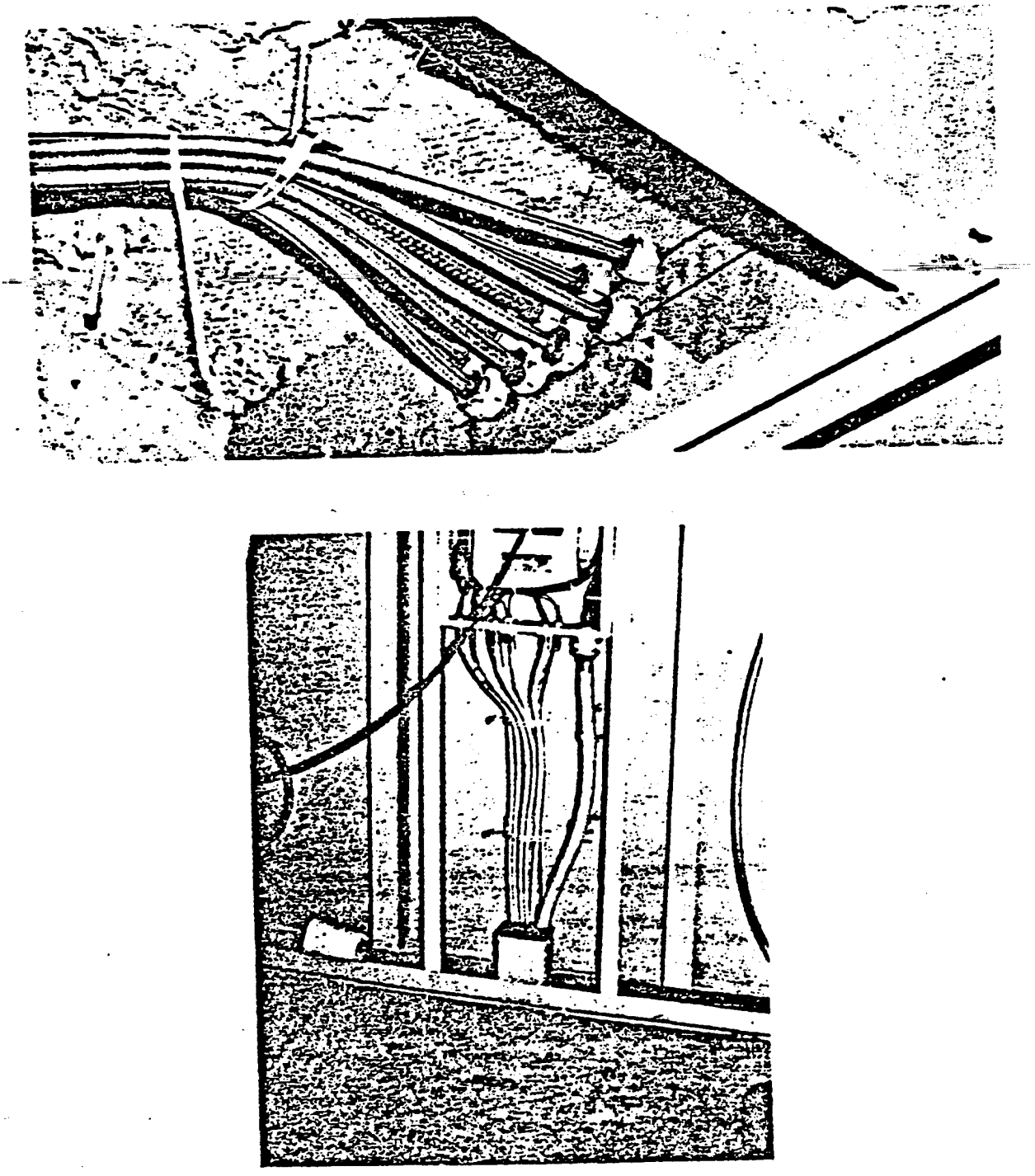


Figure 2.7.4-Typical Stuffing Tube Penetrations.

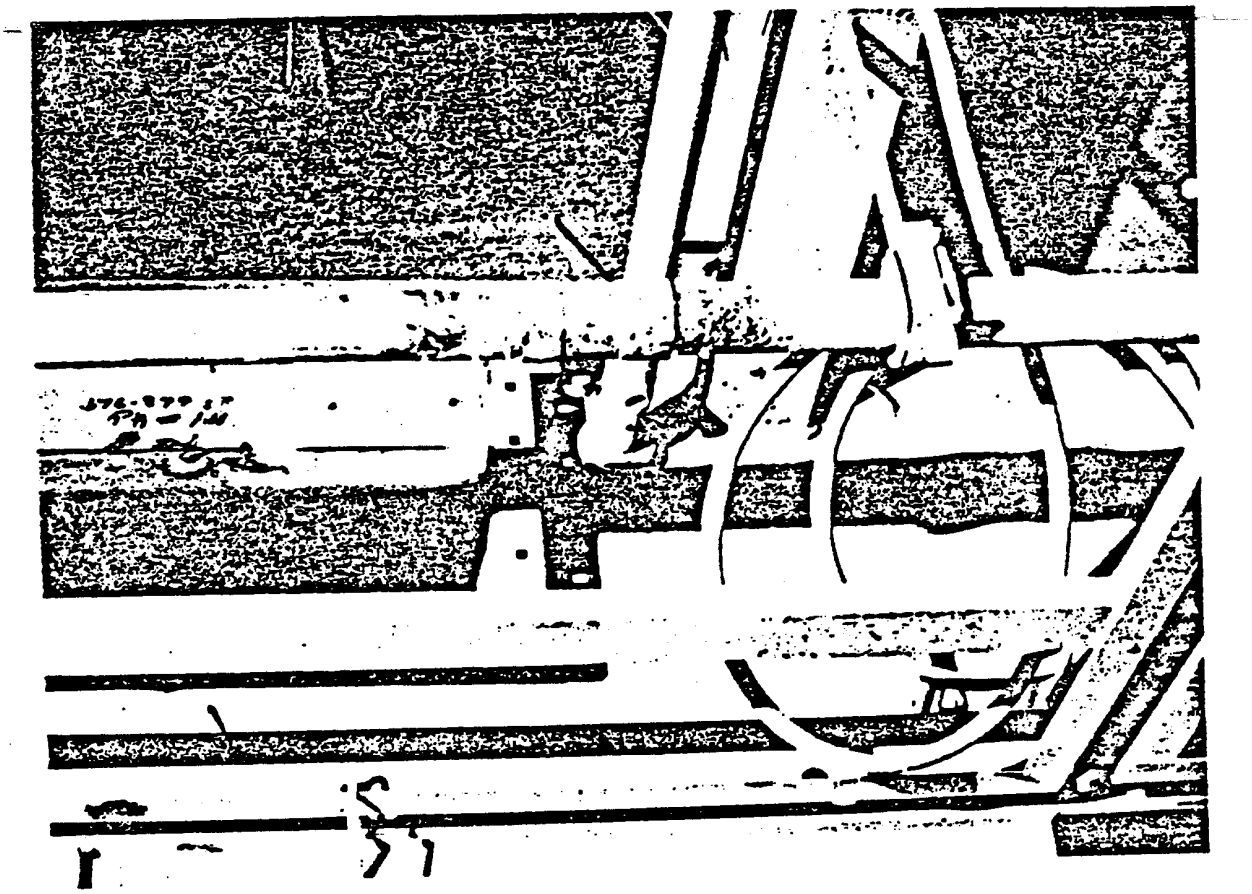


Figure 2.7.5-Flange Through Bulkhead for Ventilation Duct.

stuffing tubes and approved multiple cable penetration devices are only capable of meeting A-0 or B-0 Class requirements. If the division penetrated is required to be insulated, insulation approved in accordance with 116 CFR 1611.007 must be applied to the cable penetration, and at least 12 inches along the cable on the insulated side of the division.

Ducting

When ventilation ducting penetrates A- or B-Class divisions, adequate means must be provided to maintain the integrity of the division. Due to the requirements for fire dampers at penetrations (see Section 3.11), it is often desirable to arrange duct work so that a minimize number of bulkheads and decks are penetrated. Aboard passenger vessels, there are restrictions which prohibit stairway and stairtower ventilation systems from serving any other space. There is also a requirement that no duct may serve two main vertical zones.

Where steel ducts penetrate steel A- or 3-Class divisions, the duct should either be welded or flanged to the division, figure 2.7.5, or run through a tight-fitting sleeve. As with other penetrations, whenever ducts pass through insulated steel divisions, insulation approved in accordance with 46 CFR 164.007 is required on the duct for. a distance of 12 inches from the division. Two exceptions to the 12-inch requirement exist (1) aboard passenger vessels - vertical ventilation ducts which serve cargo or main machinery spaces which pass through accommodations or safety areas must be insulated to the applicable bulkhead requirements for 6 feet beyond the division (46 CFR 72.05-50(g), and (2) aboard tank vessels - any ventilation duct which serves Category A machinery spaces that passes through accommodation, service, or control spaces must be constructed to A-60 Class requirements or constructed of steel, fitted with an automatic fire damper at each boundary where it enters and leaves the machinery space, and insulated to A-60 Class requirements for a distance of 5 meters (16.4 ft) beyond each machinery space boundary (46 CFR 32.56-60).

2.8 Doors

Unlike bulkheads and decks, doors are not required to meet any fire test requirements. It was felt that due to the limited amount of combustibles stowed adjacent to doors, and because doors must be capable of opening and closing, an equivalent amount of integrity could be provided by specifying construction requirements for doors. Most doors are constructed of steel, and in some cases they are also insulated with approved structural insulations. No specific requirements are listed for hardware such as hinges, frames, latches, and closers, but manufacturers, in general, use steel components similar to those tested by U.L.

For doors which are installed in A-Claus bulkheads, the following general requirements exist:

(1) The door. must be of steel or equivalent metal construction. Generally, a double thickness of 16 USSG or a single thickness of 11 USSG is acceptable.

(2) The doors must have a latch which can be operated from either side with a minimum throw of 3/4 inch.

(3) The bottoms of the doors may be undercut, up to a maximum of 1/2 inch.

(4) Door frames must provide a minimum of 112 inch door stop at the sides and top. However, only a 318" overlap of the door on the frames is considered necessary.

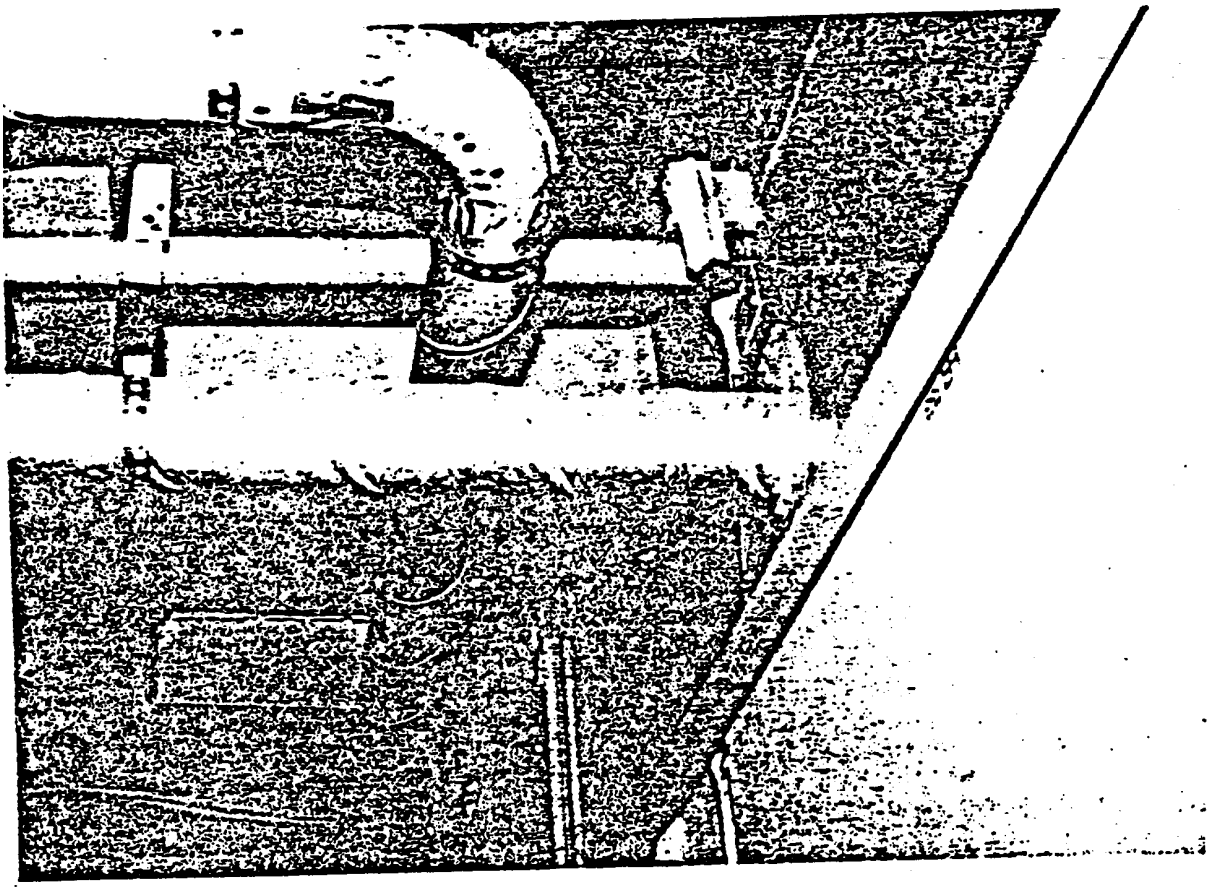
(5) maximum of 100 square inches of wire-inserted glass may be installed in each door.

(6) Vent grilles or louvers are prohibited in A-Class doors.

Double doors in A- or P-Class bulkheads must meet the following additional requirements:

(1) Double doors capable of independent operation and latching may have a maximum gap between the doors of 1/8 inch. Doors which must be sequentially closed must have a 1/2 inch door stop or astragal strip mounted on the door which closes first.

(2) Double swing doors may have a maximum gap of 118 inch at the top and sides.



Penetration of B-Class Corridor Bulkhead for Stateroom Ventilation.

Doors installed in stairways or main vertical zone bulkheads aboard passenger vessels must meet the following additional requirements.

(1) Doors not normally locked must be self-closing and be capable of closing against a 3-1/2 degree list.

(2) Doors may not be held open with holdback hooks. Magnetic holdbacks with remote control release on the bridge may be used.

(3) Doors in main vertical zone bulkheads may not be fitted with hose ports.

Where doors are to be installed in 3-Class bulkheads, the following general requirements must be met:

(1) Door must be of steel, hollow steel, or equivalent metal construction. A single thickness of 16 USSG steel or a double thickness of 22 USSG steel is acceptable. Approved non-combustible materials may be used if specifically approved by the Commandant. Aluminum doors may be used if fire tested and approved for specific locations by the Commandant.

(2) All glass installed in B-Class doors must be wire-inserted glass.

(3) B-Class doors may have a vent or louver in the lower half, not to exceed 2 square feet in area. This louver may be designed as a vertical duct within the door. which opens on the upper side of the door on the passageway side. This is to provide noise reduction in the stateroom.

(4) The doors must have a latch capable of operation from either side with a minimum throw of 3/8 inch.

(5) The doors may be undercut up to a maximum of 1 inch.

(6) Door frames must provide a minimum ½ inch door stop on the sides and top; however, only a 3/8 inch overlap of the door on the frame is considered necessary.

Additional requirements for specific types of doors are as follows:

(1) Doors for installation in A-60, A-30, and A-15 Class bulkheads must meet the requirements for A-Class doors and must also be filled with approved structural insulation. These doors need not be insulated to A-60 or A-30 standards, but require sufficient insulation to meet A-15 standards. One half of the thickness of structural insulation approved under 164.007 provides A-15 construction.

(2) Doors opening onto weather decks may be aluminum, or oak or similar hardwood having a minimum thickness of 1-3/4 inch. This requirement applies only to doors on the aide of superstructures which do not face the cargo area.

(3) Doors to be installed in C-class bulkheads must be constructed of approved. non-combustible materials.

2.9. Tonnage Openings

Whenever tonnage openings are made in A-Class boundaries, they should be closed by steel plates of at least 11 USSG and held in place by steel hook bolts. No gaskets or caulking are permitted around the plate. Where tonnage openings are installed in A-15, A-30, or A-60 divisions. the cover plate should be insulated to the same standards as the division penetrated. Additional insulation is not considered necessary over the hock bolts; however, care should be taken to insure that the gap between the Insulation on the division and the insulation on the cover plate is as small as possible.

2.10 Window: and Glass

Windows or portlights are generally constructed with bronze or steel frames, figure 2.10.1. Additionally, where external windows are fitted in joiner bulkheads, a 16 USSG steel casing, figure 2.10.2, should be provided to act as a fire barrier between the joiner bulkhead and the shell of the vessel. Steel frames and steel glazing beads or angles to keep the glass in place are generally required in steel or other fire resistant bulkheads. 30th steel and glass are noncombustible and have high melting points. Use of frames such a: aluminum with a low melting point in an otherwise fire resistant bulkhead can only be accepted where steel retaining clips, connected to the bulkhead, support the glass in place if the frame melts away. Similarly, melting of frames or burning of combustible a baskets should not leave large gaps which would permit passage of fire and smoke. For those areas where “wire inserted” glass is required, it should be noted that heat treated glass is not acceptable as a substitute. The minimum acceptable thickness for all glass is 1/4 inch. The maximum allowable spacing between wires in wire inserted glass is two inches. Section 5.0 contains specific requirements for Tank vessel superstructures.

3.0. Construction and Arrangement

The specific Coast Guard rules and regulations relating to the structural fire protection of vessels are contained in the Code of Federal Regulations under Title 46 -- Shipping. They have been subdivided as follows:

(1) 46 CFR 30-40 (Subchapter D -- Tank Vessels)

(2) 46 CFR 70-80 (Subchapter H -- Passenger Vessels)

(3) 46 CFR 90-105 (Subchapter I -- Cargo and Miscellaneous Vessels)

(4) 46 CFR 107-113 (Subchapter I-A -- Mobile Offshore Drilling Units)

(5) 46 CFR 166-168 (subchapter R -- Nautical Schools)

(6) 46 CFR 175-187 (Subchapter T -- Small passenger Vessels (Under 100 gross tons))

(7) 46 CFR 188-196 (Subchapter U -- Oceanographic vessels)

The various subchapters may be purchased at nominal cost from the superintendent of Documents, U.S. Government printing office. Washington. D.C. 20402.

The structural fire protection regulations for all vessels have been developed from the original rules for passenger vessels. Many of the other subchapters are not as explicit as the passen'1er vessel rules. If there is a question of interpretation in one of these subchapters, it has been the policy of the Coast Guard to use 46 CFR subchapter H for guidance. Table 3.0 is a basic list of requirements for passenger, tank, and cargo vessels which provides a numerical reference to the appropriate regulations.

It is the intent of this guide to illustrate standard design features which have been accepted as "good marine practice" and interpretations which also comply with the intent of the regulations. The rules and regulations for cargo and tank vessels have been purposely written in fairly general terms to provide design flexibility.

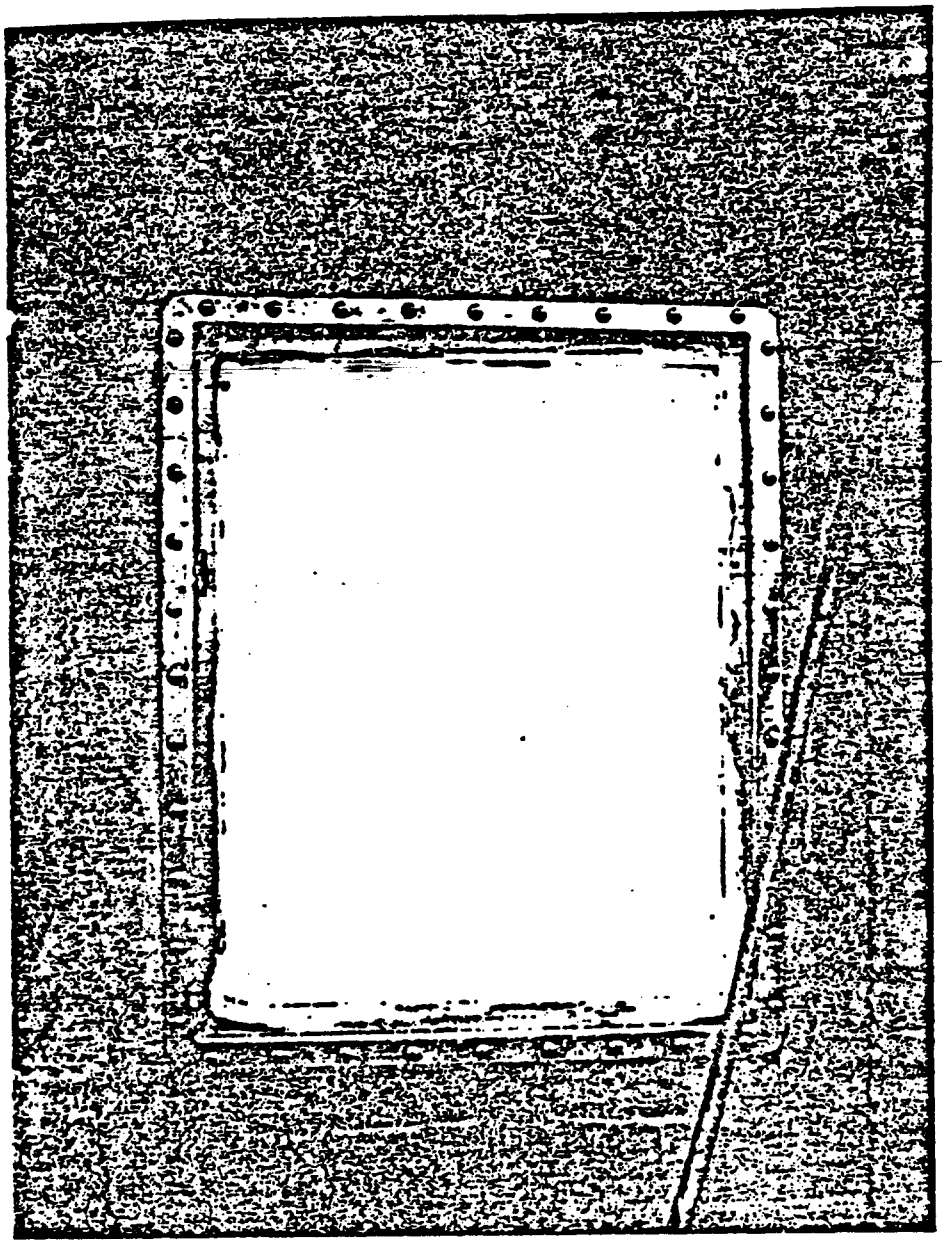


Figure 2.10.1-Typical Steel Window Frame.

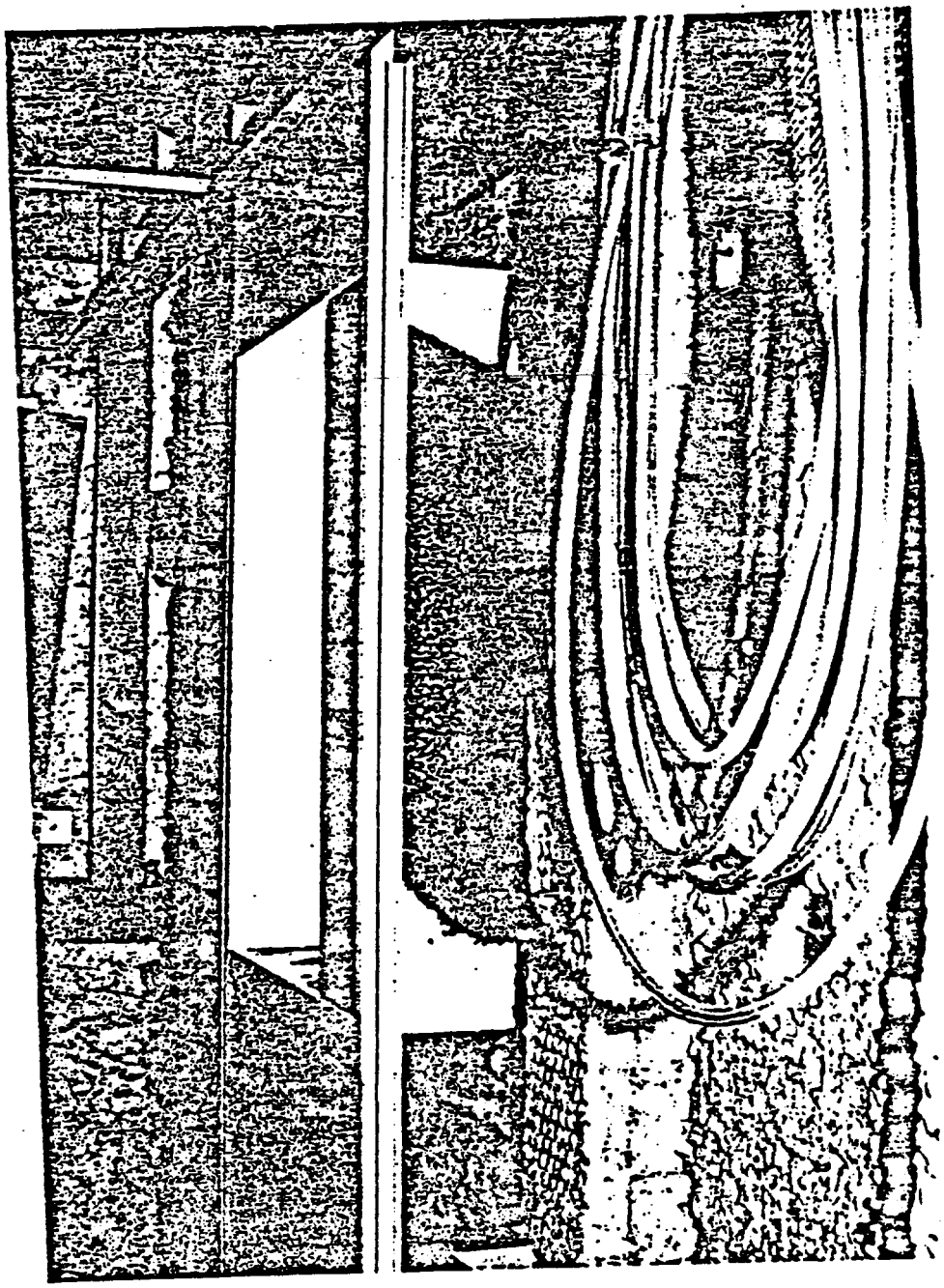


Figure 2.10.2-Typical Joiner Bulkhead Window Casing.

The specific vessel regulations should be consulted to determine the regulatory requirements prior to using this guide. This is of particular importance because the requirements for same vessels are more stringent than others.

3.1 Bulkheads.

When designing a vessel, it is beneficial to realize that the location of bulkheads may serve several purposes. primarily bulkheads are located to act as structural members and, secondly, they can be an element of the structural fire protection system. A shipboard fire can spread until some form of containment is met. If structural fire protection is not incorporated in the bulkheads of a compartment, the fire can burn freely, consuming the contents and bulkheads of the space and can move on to adjacent spaces. This process may continue until the available fuel supply is consumed; however. by such time, the vessel is generally lost. Structural fire protection boundaries provide containment to limit the spread of fire and. in some cases, smoke. These boundaries are designed to contain potential fires for a period of time which will allow the fuel load in the compartment to be consumed, causing self extinguishment of the fire; or for extinguishment to be effected by the fire control party. provisions are also made to insure against the spread of fire to adjacent compartments by preventing the conduction of heat into these spaces, which could ignite combustibles and cause the start of other fires. The degree of structural fire protection necessary to accomplish this task depends upon factors such as the type and amount of fuel available for combustion in the protected space and the contents of the adjacent spaces. Experience and full-scale testing have provided a realistic measure of fire-endurance requirements for bulkheads that are currently contained in the regulations.

A-Claus Bulkheads,,

A-Class bulkheads were originally required only aboard passenger vessels for “fire-resisting" boundaries called main vertical zones, spaced at intervals of 131 feet. Currently, A-Class boundaries are also required aboard cargo and tank vessels as well to contain fires in high potential hazard areas such as machinery spaces. galleys, and cargo holds. A-Class bulkheads are also required to protect areas such as control stations and stairtowers.

A-Class bulkheads are not required to perform any structural purpose relating to the strength of the vessel; however, a carefully planned vessel design could combine both structural strength and fire-endurance requirements.

A-Class bulkheads, in some locations, are required to have insulating capabilities. There are four types of A-Class bulkheads, each type being alpha-numerically designated to indicate its insulating capability. i.e.. A-60, L-30, A-15, and A-0 Class. An A-0 Class bulkhead is a minimum 11 USSG steel plate. .A-30 and A-15 Class bulkheads are similar to A-60 Class bulkheads but are insulated with reduced thicknesses of approved structural (1 6£I. Q07) insulation. The reduction in thickness of insulation has been determined by either full scale or laboratory furnace tests. In general, if S inches of insulation is required for 60 minutes of thermal protection, 30 minutes of protection can he achieved with (.75)8 inches of insulation and 15 minutes of insulation can be achieved with (.5) S inches. Figures 3e 1 e 1 through 3e 1.5 show acceptable arrangements for steel A-GO, A-30, and R-15 assemblies. Any other arrangement of components is unacceptable unless fire tested to verify the performance of the assembly. These alternative arrangements must be approved by the Commandant.

Table 3.0

Structural Fire Protection Reqirements
Within Accommodations and Service Areas.

Requirement	Passenger Vessel	Tank Vessel	Cargo & Miscellaneous Vessel
Lamp, paint, and oil locker construction	Steel - A-Class 46 CFR 72.03-15(a)	Steel - A-Class 46 CFR 32.57-10(b)	Steel - A-Class 46 CFR 92.07-10(b)
Hull, Superstructure, structural bulkheads, decks, and deckhouse construction	Steel - A-Class 46 CFR 72.05-10(a)	Steel - A-Class 46 CFR 32.57-10(a)	Steel - A-Class 46 CFR 92.07-10(a)
Emergency generator room construction	Type 1 Space, Tables 46 CFR 72.05-10(d)-(g)	Steel - A-Class 46 CFR 32.57-10(b)	Steel - A-Class 46 CFR 92.07-10(b)
Construction of boundaries separating accommodations and control stations from cargo spaces, machinery spaces, galleys, main pantries and storerooms	See Tables 46 CFR 72.05-10(d)-(g)	Steel - A-Class 46 CFR 32.57-10(c)	Steel - A-Class 46 CFR 92.07-10(c)
Corridor bulkhead construction	Type 3 Space, intact from deck to deck Tables 46 CFR 72.05-10(d) & 72.05-10(e)	A or B-Class intact from to deck 46 CFR 32.57-10(d)(1)	A or B-Class intact from deck to deck 46 CFR 92.07-10(d)(1)

Table

Structural Fire Protection Requirements
Within Accommodations and Service Areas.

Requirement	Passenger Vessel	Tank Vessel	Cargo & Miscellaneous Vessel
Stairtower, dumbwaiter elevator, and other trunk construction	Type 2 Space, Table 46 CFR 72.05-10(d)-(g)	Steel - A-Class 46 32.57-10(d) (2)	Steel - A-Class 46 CFR 92.07-10(d) (2)
Stateroom boundary construction (Not corridor side)	Type 5 or 6 space, Tables 46 CFR 72.05-10(d)-(g)	A, B, or C-Class 46 CFR 32.57-10(d) (3)	A, B, or C-Class 46 CFR 92.07-10(d) (3)
Stairway construction	Enclosure at one level only in accordance with 46 CFR 72.05-20(c) (2)	A or B-Class bulkheads and doors at one level only 46 CFR 32.57-10(d) (4)	A or B-Class bulkheads and doors at one level only 46 CFR 92.07-10(d) (4)
Stairtower construction	Enclosure trunk and doors at all levels in accordance with 46 CFR 72.05-20(c) (1)	A-Class trunk and doors at all levels 46 CFR 32.57-10(d) (4)	A-Class trunk and doors at all levels 46 CFR 92.07-10(d) (4)
Interior stairs construction (stringers & treads)	Steel 46 CFR 72.05-20(j)	Steel 46 CFR 32.57-10(d) (5)	Steel 46 CFR 92.07-10(d) (5)
Requirements for Deck Coverings (except toilet & washroom spaces)	3/8" or less of any material. Thicker materials must have 164.006 approval. 46 CFR 72.05-10(n)	3/8" or less of any materials. Thicker materials must have 164.006 approval. 46 CFR 32.57-10(d) (6)	3/8" or less of any material. Thicker materials must have 164.006 approval. 46 CFR 92.07-10(d) (6)

Table 3.0

Structural Fire Protection Requirements
Within Accommodations and Service Areas.

Requirement	Passenger Vessel	Tank Vessel	Cargo & Miscellaneous Vessels
Requirements for ceilings, linings, insulations, pipe and duct laggings	Approved 164.009 material 46 CFR 72.05-15 46 CFR 72.05-40	Approved 164.009 material 46 CFR 32.57-10(d) (7)	Approved 164.009 material 46 CFR 92.07-10(d) (7)
Requirements for sheathing, furring or holding pieces incidental to securing of bulkheads linings, ceilings & insulations	Approved 164.009 material 46 CFR 72.05-10(k)	Approved 164.009 material 46 CFR 32.57-10(d) (8)	Approved 164.009 material 46 CFR 92.07-10(d) (8)
Interior finish requirements (not corridors, stairways, stairtowers, or hidden spaces)	See 46 CFR 72.05-15	Up to 2mm. thickness of any material, or an approved 164.012 material or paint. NOTE - Control spaces are required to have an approved 164.012 material. 46 CFR 32.56-50	Up to 2/28" thickness of any material, or an approved 164.012 material or paint 46 CFR 92.07-10(d) (9)
Interior finish requirements for corridors, stairways, stairtowers, and concealed spaces.	See 46 CFR 72.05-15	An approved 164.012 material or paint 46 CFR 32.56-50(b)	An approved 164.012 material or paint 46 CFR 92.07-10(d) (9)
Requirements for Draft stops behind ceilings and linings if bulkheads are terminated at ceiling	Every 45 feet or less. 46 CFR 72.05-10(a)	Every 14 meters or less. 46 CFR 32.56-45	No Requirement.

Table

Structural Fire Protection Requirements
Within Accommodations and Service Areas

Requirement	Passenger Vessel	Tank Vessel	Cargo & Miscellaneous Vessel
Requirements for rugs and carpets in corridors, stairways and stairtowers	Wool or equivalent 46 CFR 72.05-10(o) Type 5 spaces must also meet this requirement. 46 CFR 72.05-55(a)(4)	No Requirement	No Requirement

Steel pins and clips or other mechanical means are used to attach approved structural insulations to steel bulkheads. The pins are welded to the bulkhead and the insulation is then impaled on the pin and locked on with a speed clip. Accepted dimensions for these assemblies are: 1/8 inch diameter pins spaced on 12 inch centers with 1-1/4 inch diameter speed clips, figure 3.1.6, or the exact means used during the LIG CFR 16'1.007 approval test. Structural insulations are generally mounted by mechanical means. The use of adhesives is discouraged due to problems associated with aging and combustibility of the adhesive. After several years of installation. the performance of an adhesive under fire conditions cannot be guaranteed. Some types of approved insulations are mounted by being sprayed directly onto the bulkhead. It should be noted that the approval tests for these type materials involved only steel bulkheads. For application to aluminum bulkheads, additional investigation may be required. When structural insulations are installed, they should not terminate at the edge of the bulkhead or deck insulated, but should wrap around the joint and continue for at least 12 inches to prevent heat transfer through the edges, figure 3.1.7. One additional interpretation concerns deep web beams or frames. When insulating the under-side of a deck, the steel structural elements also require insulation. To prevent the use of excessive amounts of insulation. i~ is only considered necessary to insulate steel deep webs 12 inches below decks or away from bulkheads or the shell, figure 3.1.8.

B-Class Bulkheads

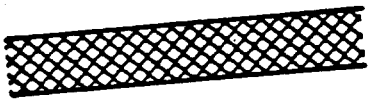
Generally, 3-Class bulkheads are 4 by 8 foot panels of 3/4 inch thick, non-combustible, binder board formed of asbestos[1] gypsum, or other materials. along with various inorganic binders, and are many times laminated with melamine or steel veneers. The panel. are joined together by a system of steel connectors to form bulkheads and ceilings, hence the name joinerwork, figures 3.1.9 and 3.1.10. joinerwork is the method used to subdivide a vessel's steel structure into compartments for accommodations and various service spaces. Joiner bulkheads do not extend from deck to deck. Where they form corridors or passageways. a continuous 16 USSG steel certain is provided between the top cap of the joiner bulkhead and the overhead steel deck. The use of B-Class panels will cause void spaces above ceilings and between bulkheads and the shell. Aboard passenger vessels and tank vessels. these void spaces must he fitted with both longitudinal and transverse draft stops every 45 feet to limit the maximum area within the void space. The draft stops should be non-combustible materials which meet a minimum B-0 requirement or alternatively. 22 gauge steel. The steel joinerwork or connector system used for bulkhead panels is very important. It is tested along with the bulkhead panel for its fire-endurance capability and its ability to prevent the transfer of heat, as well as its ability to remain in place during fire exposure. Each bulkhead panel that is Coast Guard-approved has specific joinerwork details noted as part of its approval. These plans are normally prepared to the following guidelines:

(1) A sufficient number of vertical sections extending from deck to overhead should be shown to cover all pertinent installations on board the vessel. Separate details should be shown for all variations that are installed. Details should clearly depict the following:

(a) Base and overhead fixation of the basic panel.
(b) ceiling or lining attachments to the basic panel (if applicable).
(c) Draft stop attachment to the basic panel and overhead (if applicable).

[1] See NVC 5-80, "Recommended Procedures for Control of Asbestos Hazard on Board Merchant Vessels, OCS Facilities and Deepwater Ports."

Approved Structural Insulation
46 CFR 164.007



Approved Bulkhead Panel
46 CFR 164.008

11 USSG Steel

S=Thickness of Approved Structural Insulation to meet Class A-60 requirements without other insulating materials.

P=Thickness of Approved Bulkhead Panel to meet Class B-15 requirements. The use of fractional values of P will be accepted for homogeneous materials only.

CLASS A-60 BULKHEADS

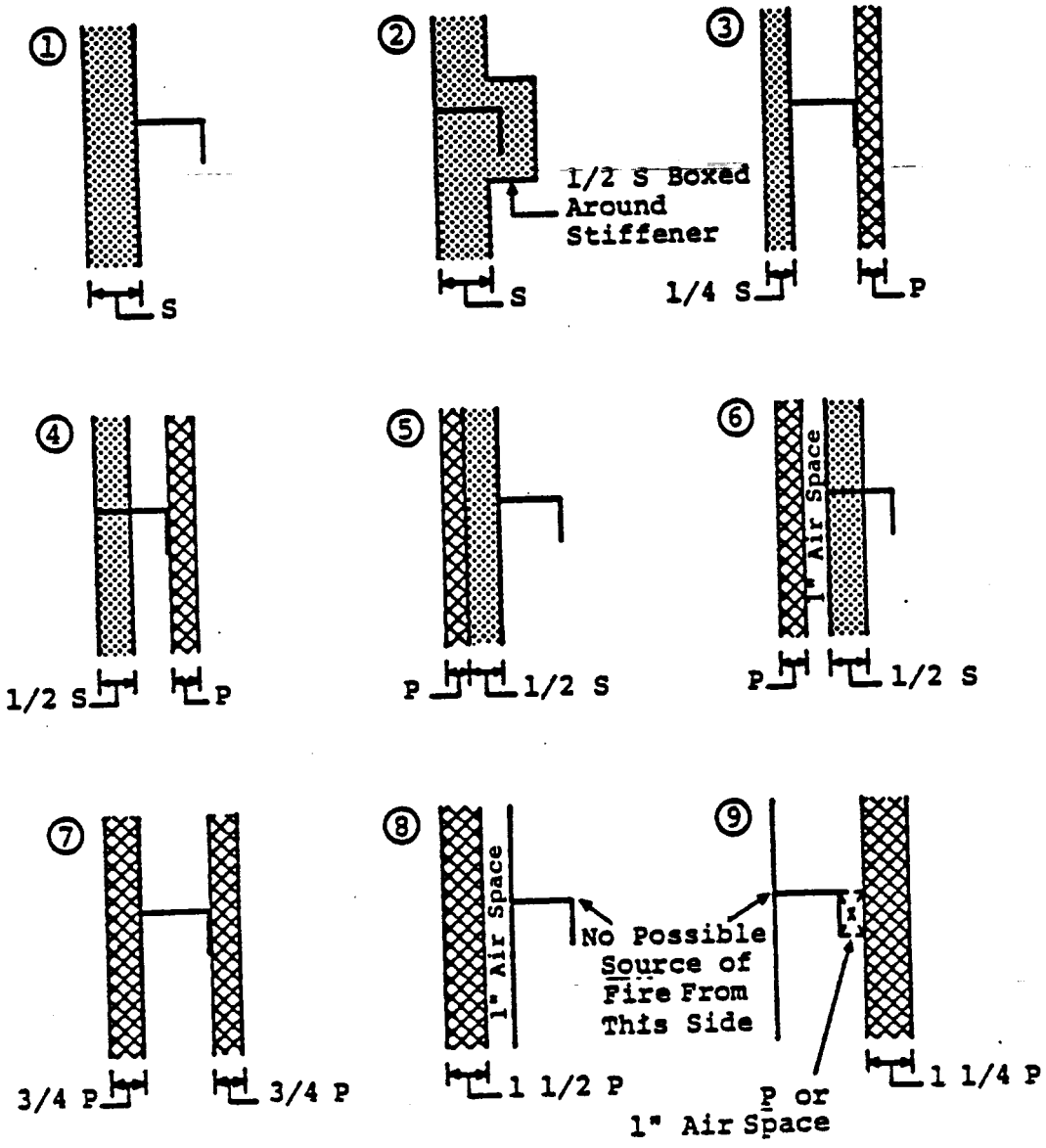


Figure 3.1.2

CLASS A-30 BULKHEADS

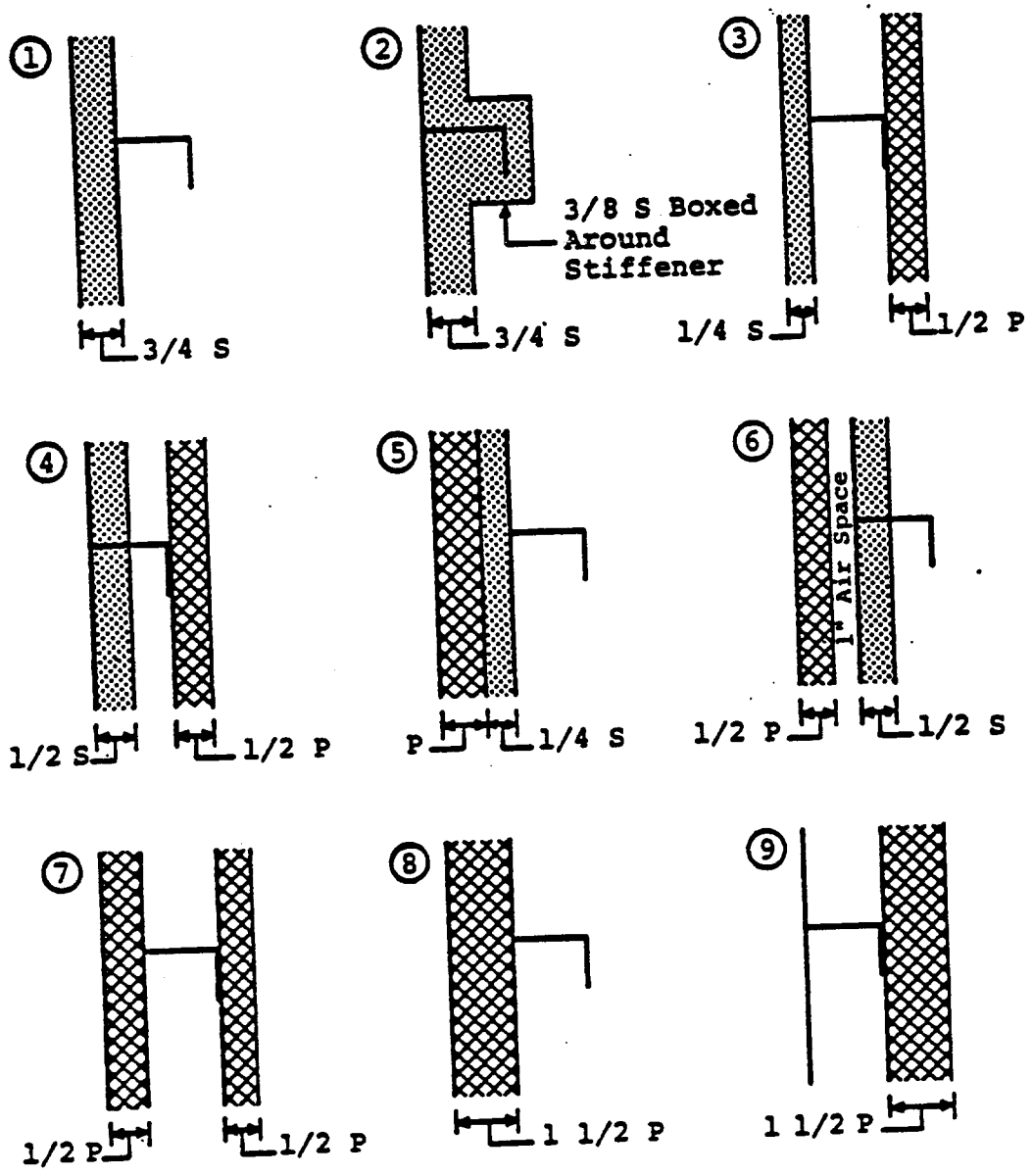


Figure 3.1.3

CLASS A-30 BULKHEADS

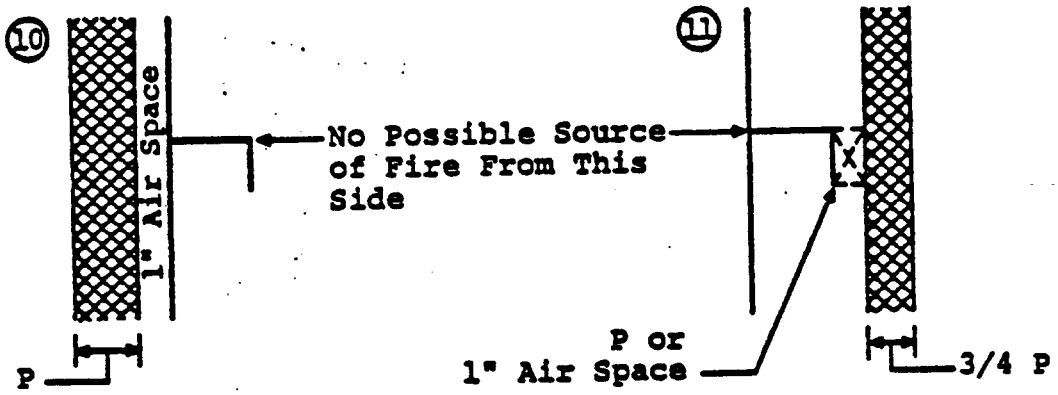


Figure 3.1.4

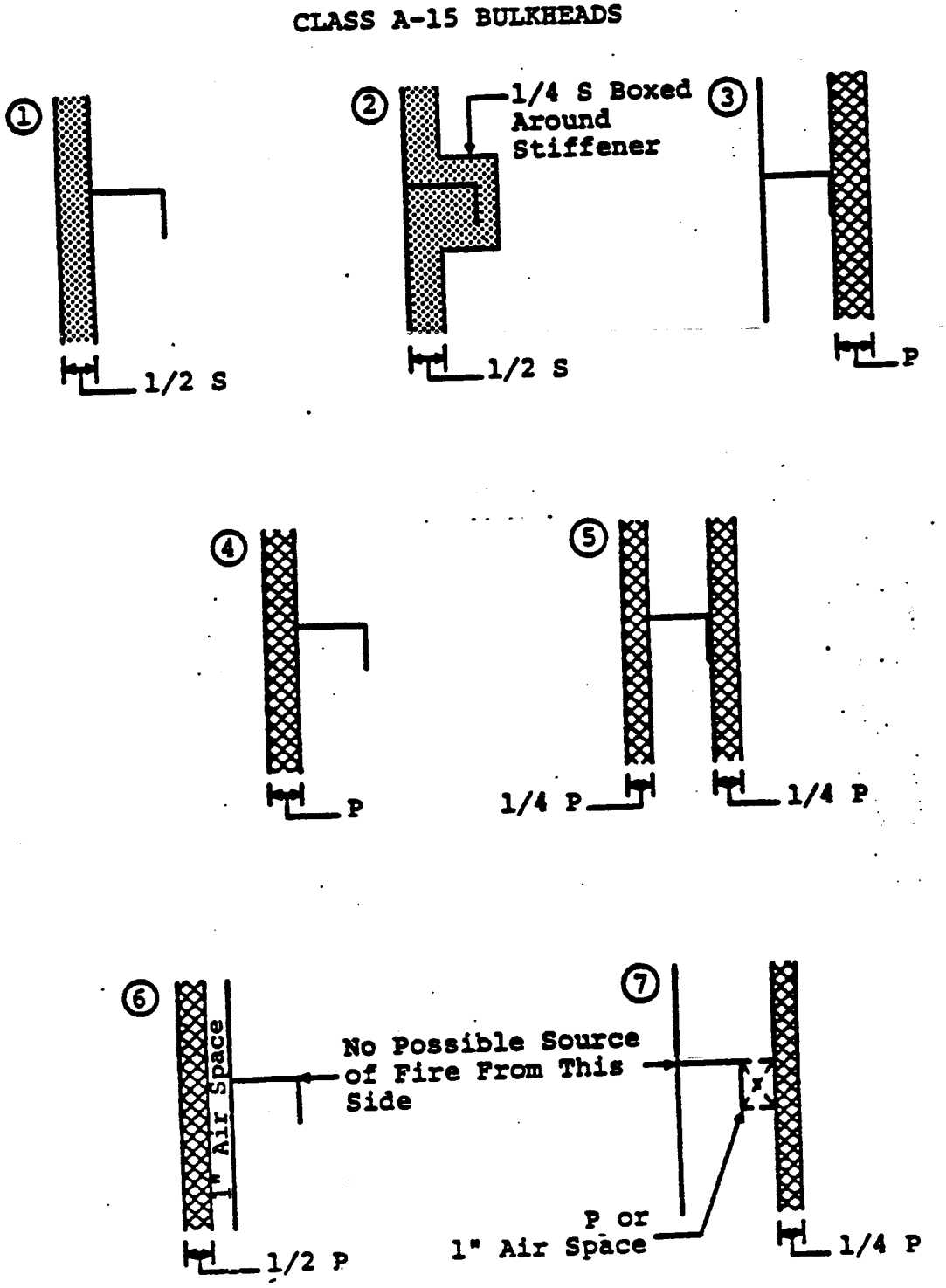

CLASS A-15 BULKHEADS
1
1/2 S
2
1/4 S Boxed Around Stiffener
1/2 S
3
P
4
P
5
1/4 P
1/4 P
6
1" Air Space
1/2 P
7
No Possible Source of Fire From This Side
P or 1" Air Space
1/4 P

Figure 3.1.5

Figure 3.1.6-Partially Completed Installation of 46 CFR 164.007 Approved Insulation. Note Steel Pins and Speed Clips.

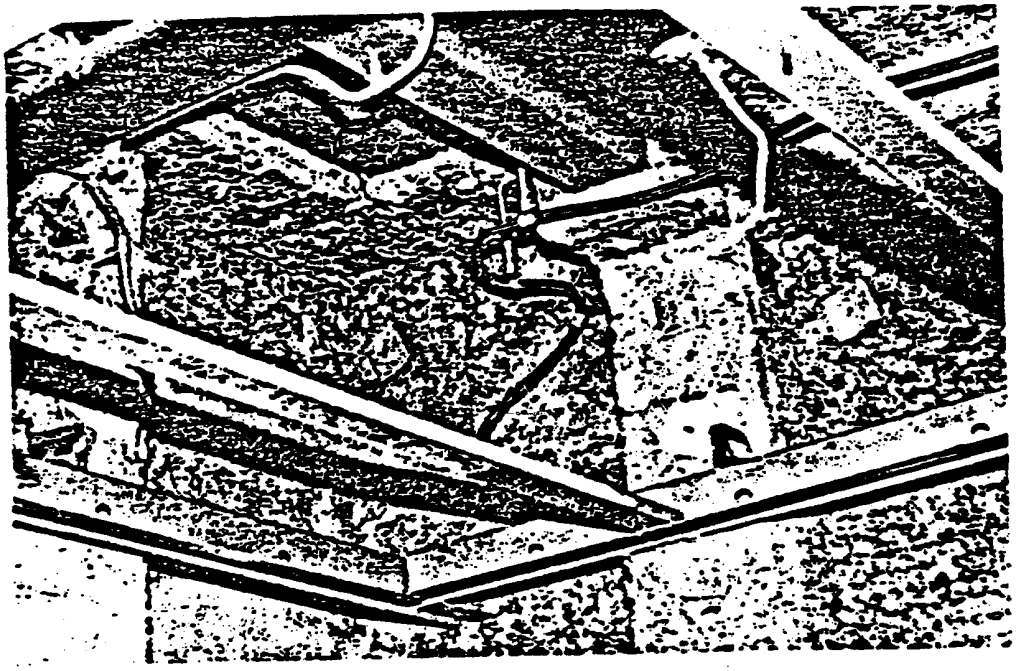


Figure 3.1.7-Typical Installation of Bulkhead Insulation Showing 12 Inch Overlap at Corners.

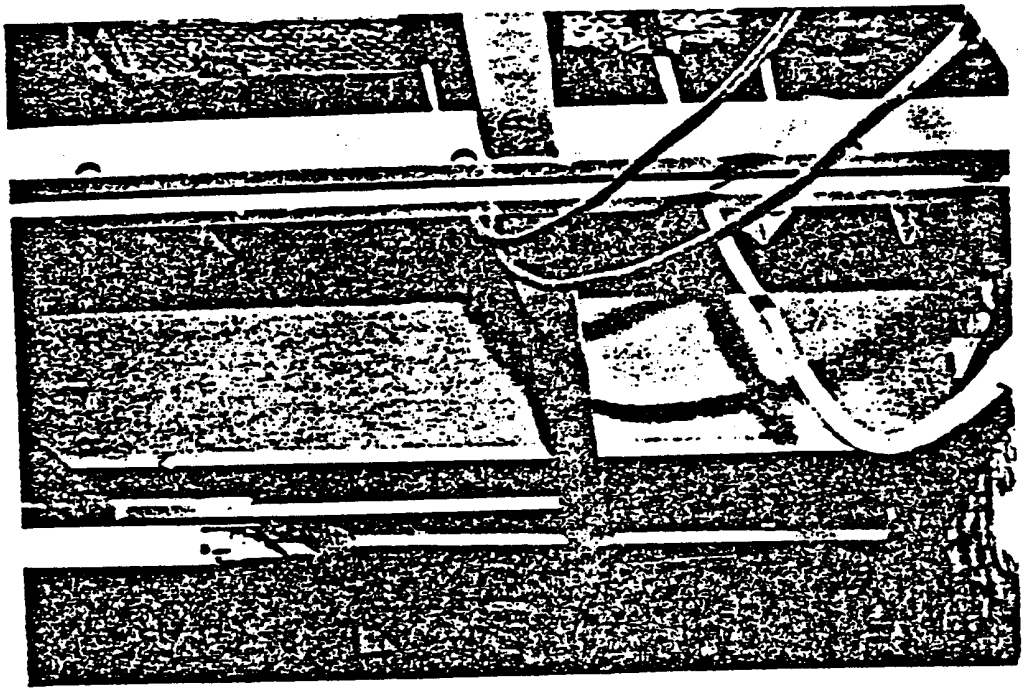


Figure 3.1.8-Insulation of Deep Web Beam. Note That Insulation Terminates 12 Inches Below Overhead.

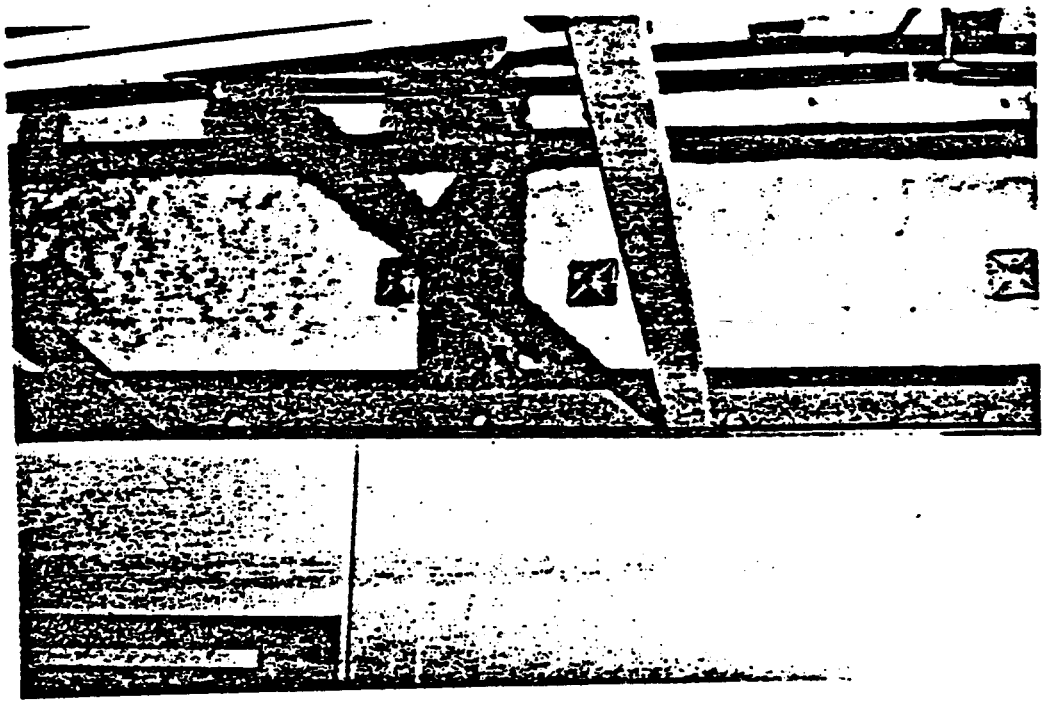


Figure 3.1.9-Joiner Work System Showing Ceiling/Bulkhead Interface.

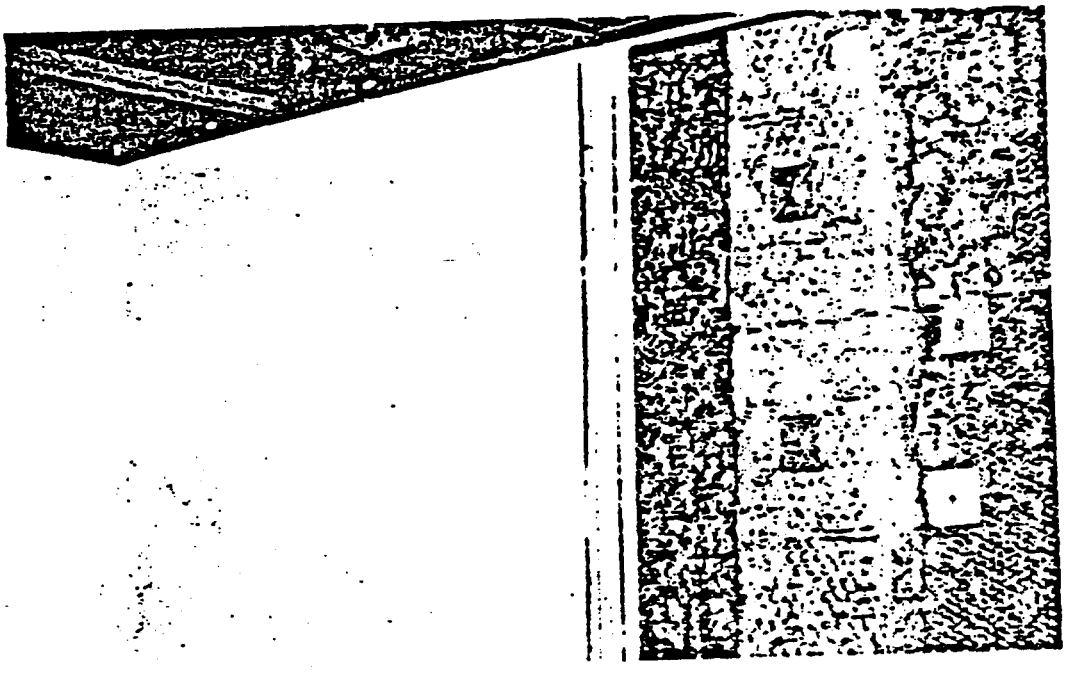


Figure 3.1.10-Joiner Work System Showing One Bulkhead Panel in Place With H-Post Connector, Awaiting Installation of Next Panel.

(d) Basic dimensions and gauges of all metallic erection pieces. such as retaining shapes. furring pieces, flat bars, and trim used for retaining purposes.

(e) The type. size, and spacing of all bolts and screws pertaining to the fixation of the basic panel or draft stop.

(2) A sufficient number of horizontal sections should be shown to cover all pertinent installations on board the vessel. Details should clearly depict the following:

(a) Two bulkheads joining in a TEE where no joint occurs.

(b) Two bu

(c) Four bu

(d) Pour bu

(e) Two bulkheads butted (H post construction).

(f) Two bulkheads butted (other construction).

(g) Outside corner detail.

(h) All variation of door jam connections to bulkheads.

(i) Bulkhead to lining detail (if applicable)

(j) The type, size, and spacing of all bolts and screws pertinent to the fixation of the basic panel, effective lining, or draft stop.

(3) The heads of screws or bolts used in securing the composition panel should not rest directly against the panel itself. Metal backing plates and/or metal trim should be used.

(4) Self tapping screws or bolts, of sufficient length to completely penetrate the composition panel and the metal plate on the far side such that at least two threads of parallel-threaded section in addition to the taper length extend beyond the combined thickness of materials being joined, should be used for all screws or bolts required for panel fixation.

(5) Self tapping screws similar to Parker Kalon Screws should be at least 3~16 inch longer than the overall thickness of all material through which is passes.

(6) Self tapping Parker Kalon screws used for the fixation of effective panels, linings, ceiling, and/or draft stops should meet the following minimum requirements:

(a) Required length up to 3/8 inch - #6 on 8 inch centers.

(b) Required length 5/8 to 1 inch - #8 on 10 inch centers.

(c) Required length over 1 inch -#10 on 12 inch centers.

(7) No requirements are placed on the size or spacing of screws used to affix trim to any panel when the trim is IN NO WAY used to afford fixation for the panel.

(8) Vertical joint pouts, corner posts, and horizontal retaining shapes should be at least 16 USSG steel, except that such shapes may be folded from 20 USSG steel sheets of double thicknesses, with at least a 3/4- inch lap into the panel.

(9) All vertical butt members should be effectively fixed top and bottom in such a manner as to insure that these metallic butt members afford positive support to the panels.

(10) All horizontal members providing top and bottom panel fixation should be effectively attached to the hull or its framing.

(11) Threaded fastenings which are anchored in approved noncombustible panels may be used for decorative attachment only. Threaded fastenings providing structural support should be such that the holding power is derived from metallic seatings of the fastenings.

C-Class Bulkheads

It is sometimes desirable to install bulkheads to serve only as partitions. Theme bulkheads need perform no structural fire protection purpose; however, they must not contribute to the fuel load of the compartment in which they are installed. Bulkheads fitting this category are designated as C-Class bulkheads. C-Class bulkheads are required to be noncombustible in accordance with 46 CFR 164.009. Aboard Cargo and tank vessels, C-Class bulkheads may be used for stateroom boundaries which do not form corridors. In this installation, they are not required to extend from deck to deck.

3.2 Decks

Decks function within the structural fire protection system to limit the vertical spread of fire and smoke. Due to classification society requirements for deck plating, it is unlikely that one will ever encounter a steel deck that does not meet the minimum thickness requirements for an A-Class division. Although all decks within accommodation and service areas aboard cargo and tank vessels are not specifically required to be A-Class by the regulations, it would be imprudent to not treat these divisions as such. It is generally felt that all deck penetrations should be constructed to provide A-Class integrity.

The insulation of decks for fire protection purposes can be accomplished by two methods. One is to insulate the deck plating from beneath with structural insulations, figure 3.2.1., or bulkhead panels, and the other is to apply approved deck coverings on the topside of the deck. Because more of the materials used for the latter purpose can also act as finishing or leveling surfaces, it may be more economical to use this method for the insulation of a steel deck. Materials approved as noncombustible materials under 164.009 may also be used as deck covering without limitation.

Deck coverings are generally composed of several layers of different materials. Most steel decks are not smooth or level enough to apply a surface covering directly to the steel, so a deck covering or underlay is employed for leveling and smoothing purposes. Within service and accommodation areas, or where specifically required, deck coverings must be of an approved type; however, an overlay of up to an average of 3/8 of an inch of any material is permitted to be installed on top of the approved deck covering. This allows several options: (1) A deck may be covered with 3/8 of an inch of any material, or (2) an approved thickness of an approved deck covering may be installed beneath the 3/8 inch thick overlay. (If a Latex mastic or other material is used to bond the deck covering to the steel, it must be part of the 46 CFR l64.006 approval.), or (3) a deck covering of approved thickness can also be used alone. If a rug or carpet is to be installed, it is not considered an overlay. Deck coverings are approved by test as specified in 46 CFR 164.006. Many of the approved deck coverings are some form of magnesium oxychloride cement (magnesite). Figures 3.2.2 through 3.2.5 show acceptable arrangements for steel deck assemblies.

Rugs and Carpets

Rugs required to be wool or equivalent are any wool rug or any other rug which, when tested to ASTM standard E-84, has a flame spread rating of 75 or less and a smoke developed rating of 100 or less. If an underpad is used, it also must meet the same flame spread and smoke developed criteria. The rug must be tested exactly as it is intended to be installed; however, underpaddings may be tested separately. When carpets are installed aboard ship, the use of wooden carpet strips is acceptable. If these strips are used aboard passenger vessels, they should be included in the calculations required by 46 CFR 72.05-15(c). For all installations, rugs and carpets should not pass beneath doors. A sill or open space of a minimum width equal to the jamb depth of the door frame should be provided This gap is to insure that flame spread does not occur through undercut doors.

Combustible cove mouldings may be used at the deck-bulkhead junction; they are considered an extension of the permissible 3/8 inch overlay.

3.3 Means of Escape

As previously mentioned, the basic purpose of structural fire protection is to provide a life safety system for the ship's crew and passengers. The configuration of corridors, doors, and stairways is highly important to this system. Two means of escape are necessary from all living and working areas. The means of escape are required to be bounded by structural fire protection to maintain tenable conditions for a minimum period of time, during which escape from untenable areas may be accomplished.

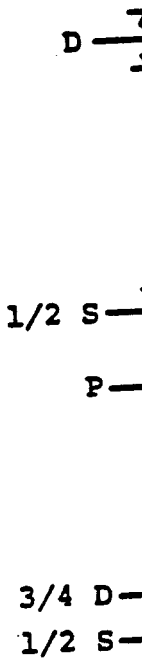
Several general principles apply to all escape routes. If the escape path involves access through watertight doors, it is possible that escape could be blocked to maintain the watertight integrity of the vessel. Therefore, at least one escape route from all areas should be independent of watertight doors. Additionally, the two means of escape should be located as far apart as possible. This concept is intended to prevent any one incident from blocking both escapes. Vertical ladders should not be used as a means of escape unless it can be demonstrated that no other arrangement is possible. In all cases, elevators must not be used as a means of escape. Dead-end corridors of more than 40 feet in length are not permitted. The 40-foot limit is normally measured from the exit of the most remote space to the point where escape in two directions is possible. Figure 3.3.1 illustrates this principle.

Legend:

D=Thic
A-6(

S=Thi(
Cla:
mat(

P=Thi(
B-1
wil


D
1/2 S
P
3/4 D
1/2 S

3/4 D-

1/2 S-

1/2 P-

Particular attention must be paid to means of escape aboard passenger vessels and 46 CFR subchapter T vessels which must comply with 46 CFR Subpart 72. Because both types of vessels can carry large numbers of passengers, it is important that escape routes be arranged to provide a rapid and smooth flow of persons to the embarkation areas. This requires that all doors in an escape path open in the direction of travel to the lifeboats, and that all doors be unlocked or provided with panic hardware which can be easily operated in an emergency. The width of escape routes should be determined on a deck-by-deck basis according to the potential number of persons

on that deck. The width should not decrease in the direction of normal escape. As a guide in determining the occupant load per deck, the following passenger densities may be used:

(1) Passenger staterooms - designed capacity.

(2) Crew stateroom - 2/3 designed capacity.

(3) Theaters, dining halls and other spaces with fixed seating arrangements - maximum seating capacity.

(4) Lounges, bars, etc. - 1 person per 20 sq. ft.

(5) working spaces - normal operating capacity.

Additional regulations are contained in 46 CFR 72.05-20.

Stairways and Stairtowers

Stairways and stairtowers form the primary means of escape from lover level deck areas. As such, it is vital that these enclosures be designed to provide a means of escape during periods of fire and also to prevent the spread of fire between decks. There are two basic designs specified by the regulations. The first involves a stairway which only penetrates a single deck. Because this enclosure is a penetration of only one deck, it is only necessary to provide a door and enclosure bulkheads at one level to prevent flame and smoke spread. The second design involves a stairway which penetrates more than one deck. Such a stairway is considered a stairtower. A stairtower is a continuous vertical steel trunk constructed to a minimum A-0 Class standard. Self closing A-Class doors are required at each entrance to an exit from a stairtower. If a lining such as joinerwork bulkheading is installed inside the A-Class trunk, draft stops should be provided at each deck level to prevent flame spread within the stairtower. Figure 3.3.2.

These are the only designs contemplated by the regulations. other designs which place several stairways (each of which penetrates only a single deck) vertically above or adjacent to each other are not considered equivalent to a stairtower and are not permitted by the regulations. This is a practice which has been permitted by various district commanders (mitt) and will no longer he permitted.

Ventilation Systems

Ventilation systems used to supply or exhaust heated or air conditioned air within accommodation and service spaces must be carefully evaluated as components of the structural fire protection system. Because the ductwork for a ventilation system is common to many spaces, it could easily cause the spread of flame or smoke if improperly designed. The current tank and cargo vessel regulations do not specifically detail the fire protection requirements for ventilation systems, but rather they specify the intended performance requirements of the bulkheads and decks penetrated by the ducting.

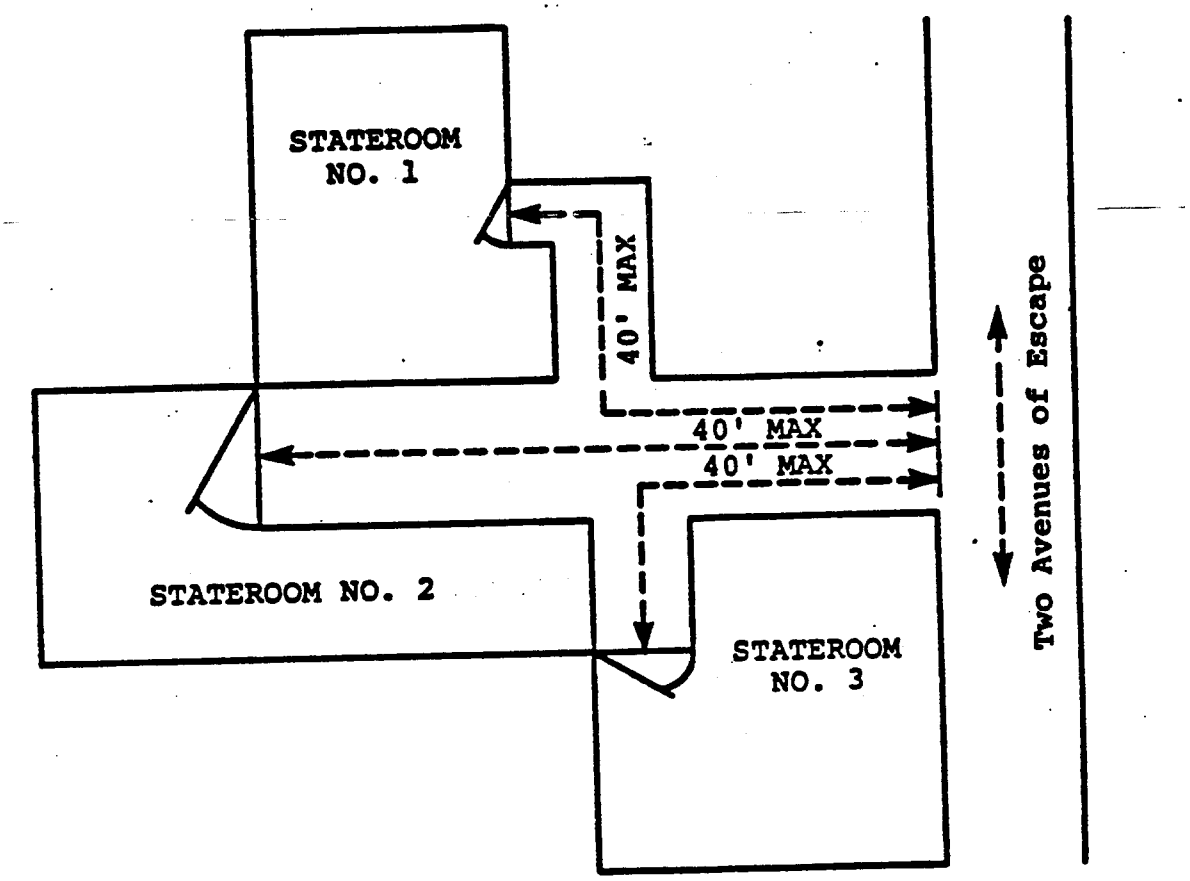


Figure 3.3.1. Dead End Corridor; Typical Permissible Limits

Boundary bulkheads of galleys, paint and lamp lockers, emergency generator rooms, and boundary bulkheads and decks separating accommodations and control stations from cargo and machinery spaces, galleys, main pantries, and storerooms are required to be of A-Class construction. penetrations of these boundaries must therefore provide an equivalent degree of protection. Another Coast Guard requirement specifies that combustible materials may not be used in hidden or concealed spaces within accommodation and service areas. Based upon the above two requirements, ventilation ducting must be constructed of non-combustible materials, and should not violate the integrity of A-Class bulkheads and decks. The Coast Guard requires a fire damper at each penetration of an A-Class division. If the ductwork is a minimum 11 USSG steel, and passes through the space without opening into that space, however, dampers need not be provided. If the duct passes through a boundary required to be B-Class, it also must meet the same requirements as that boundary, i.e., it must prevent the passage of flame for 30 minutes. It has been the policy of

the Coast Guard to accept ductwork of 22 USSG steel or heavier as meeting this requirement. If a duct constructed of 22 USSG steel or heavier is routed the length of a corridor with branches into individual staterooms, firs dampers are not required at each penetration of the B-Class corridor bulkheads. A fire damper is required at each duct opening within the corridor, if the corridor ventilation is common with the stateroom system. These general requirements are intended to allow several options when planning a vessel design. Currently several acceptable alternatives for duct arrangement exist. Figures 3.4.1 through 3.4.2 show the basic application of these principles.

Fire Damper Construction

Specific requirements for fire dampers and associated ductwork are not contained in the vessel regulations. The basic requirements for fire dampers are contained in the definition of A-Class or B-Class divisions. A duct must be equivalent to the bulkhead or deck penetrated. Therefore, the duct must be provided with a damper which meets the same requirements for flame and smoke passage. The actual physical constraints of damper construction reveal that complete closure of a damper is only possible at prohibitive cost. Therefore, dampers are designed to meet a construction rather than a performance standard. For A-Class division, fire damper blades and casings must be constructed of a minimum 11 USSG steel. A maximum gap of 1/8 inch between the blade and casing is permitted. The components (i.e., springs, hinges, etc.) of the damper must be constructed of stainless steel or other steel, suitably coated to prevent corrosion. Manually operable steel fire dampers listed and labeled by Underwriters Laboratories, Inc. as 1-1/2 hour fire dampers are acceptable, regardless of their construction. Fire dampers for B-Class divisions must be designed similarly to those for A-Class divisions; however, the thickness of steel may be reduced to a minimum 16 USSG.

Fire Damper operation

All fire dampers must be capable of manual operation. The controls for the operation of a fire damper are usually located outside the space served by the ventilation system, figure 3.4.3. Strict adherence to this requirement could produce an ineffective system. Spaces such as control stations, wheelhouses, or emergency generator rooms where it could reasonably be expected that crew members would take refuge or continuously be manned during fire exposure should be arranged to permit closure of fire dampers from inside the space.. Fire dampers which are installed in main vertical zone bulkheads must also be capable of automatic operation. These dampers must be installed to close in the direction of normal air flow to prevent their being held in the open position. Normally, automatic dampers are designed to close by the melting of a fusible link at 165^0F (Dampers installed in galleys or similar spaces are designed to operate at 212^0F) specific requirements for passenger vessels are listed in 46 CFR 72.05-50.

3.5 Elevators

Elevators are finding an increased popularity aboard types of vessels. Because elevator trunks penetrate several decks, they provide the same possibilities for flame and smoke spread as stairtowers. From a structural fire protection viewpoint, specific precautions must he taken to protect elevator trunks against flame and smoke spread.

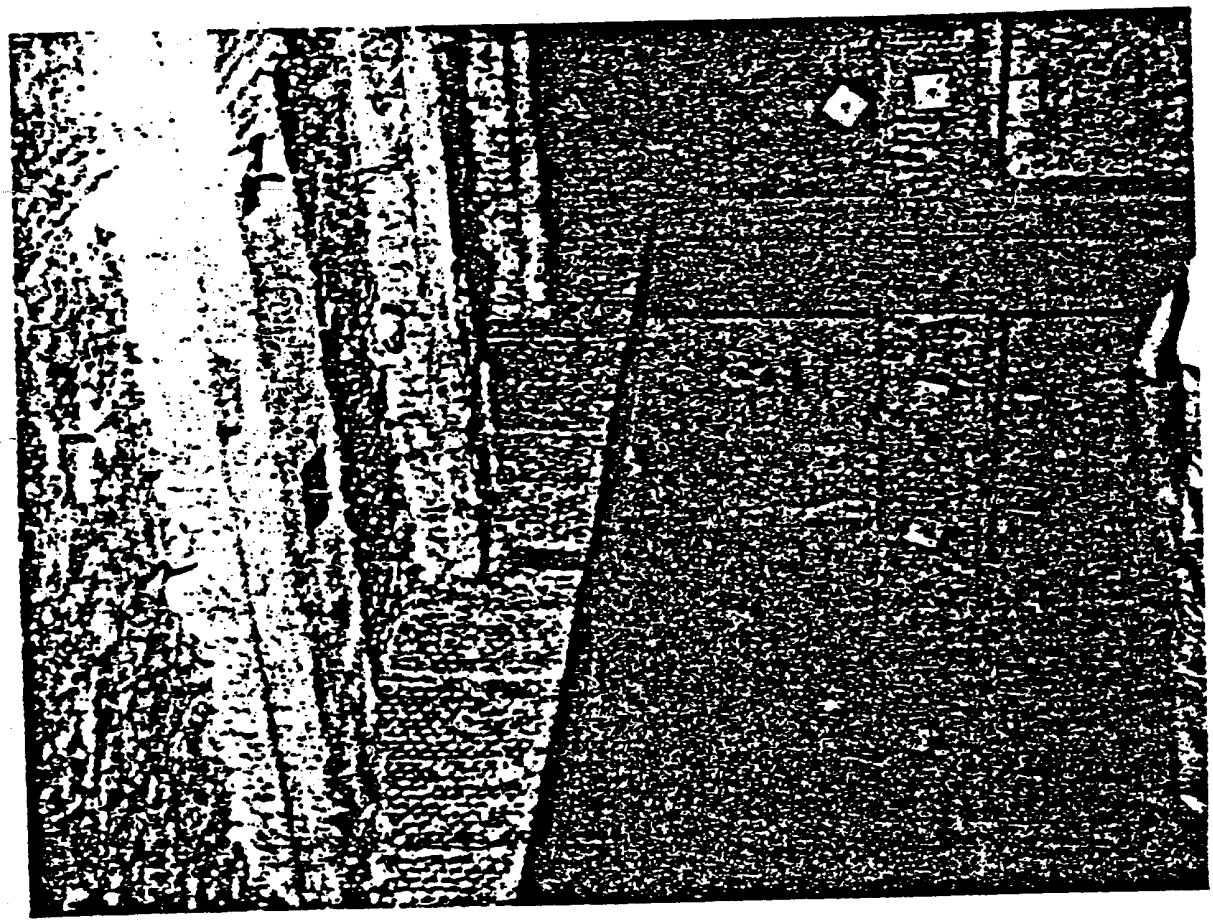
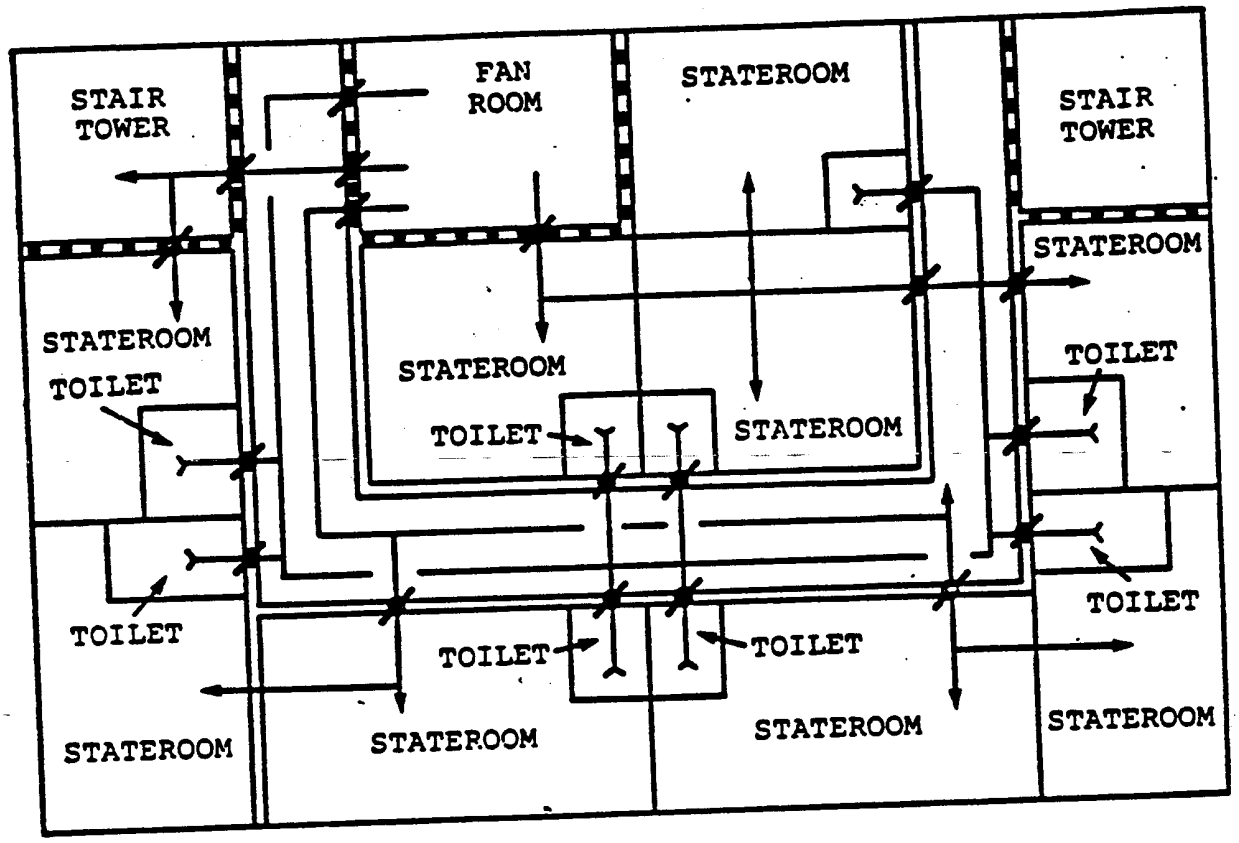


Figure 3.3.2-Draft Stop in Stair Tower Lining Between Decks.



Fire Dampers

"B" Class Bulkhead

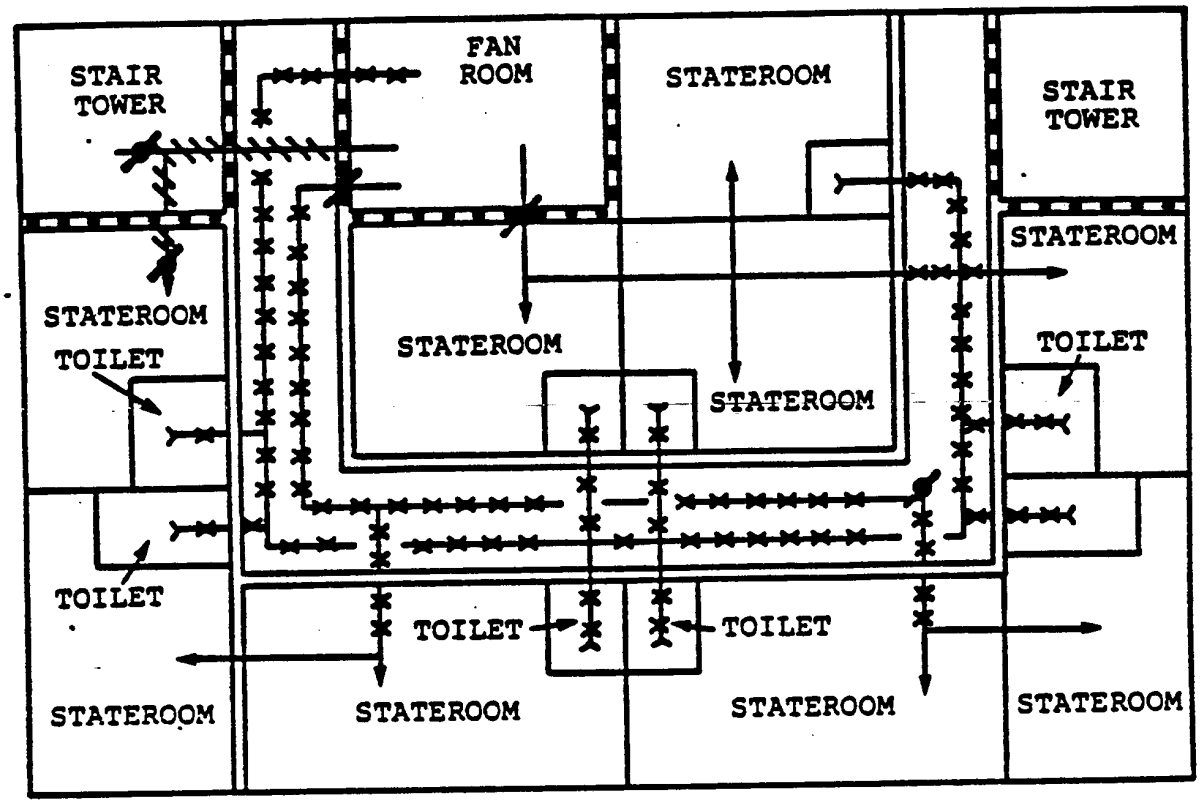
"A" Class Bulkhead

Ducting, any gauge or any noncombustible material

Ducting of at least 22 gauge steel or equivalent material

Ducting of at least 11 gauge steel or equivalent material

Figure 3.4.1



Fire Dampers

"B" Class Bulkhead

"A" Class Bulkhead

Ducting, any gauge or any noncombustible material

Ducting of at least 22 gauge steel or equivalent material

Ducting of at least 11 gauge steel or equivalent material

Figure 3.4.2

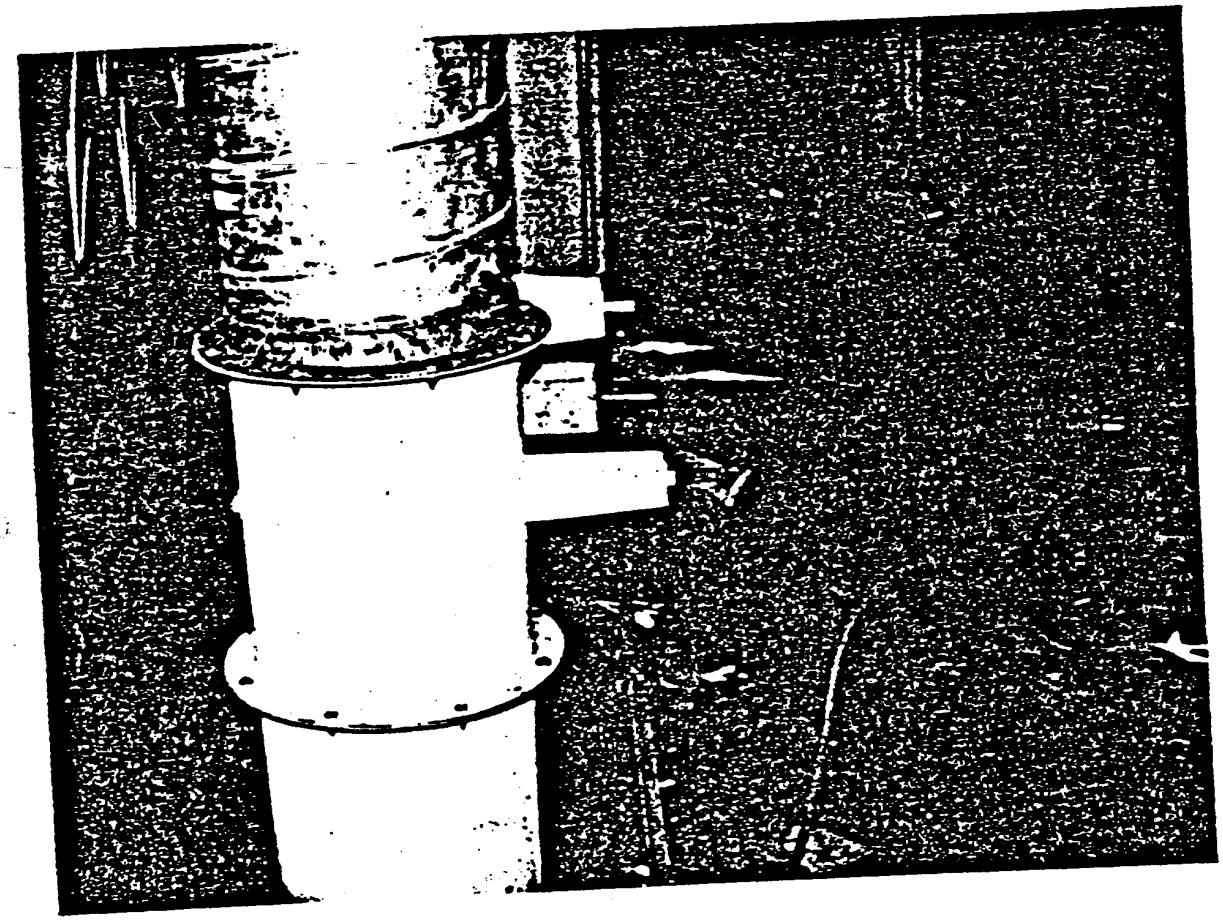


Figure 3.4.3-Typical Manual Damper Located in Space One Deck Above Service Area.

The elevator shaft. being a trunk, is required to be A-Class aboard all vessels. (Aboard passenger vessels. an elevator enclosure is considered a type 2 space and must he constructed in accordance with tables 46 CFR 72.05-10(d) -(g)). Self closing A-Class doors must be installed at all levels in addition to the elevator cab doors. Finally, all materials fitted in the elevator cab must be approved non-combustible materials.

Aboard tank vessels which have machinery spaces of category “A”, A-60 Class insulation of the machinery spaces is required. If an elevator shaft penetrates such a boundary, the entire shaft need not be insulated to A-60 Class standards. provided the machinery space insulation is installed on the underside of the deck and is carried twelve inches along the shaft.

3.6 General Design Considerations

In previous sections, the various components of the structural fire protection “Life Safety System” have been individually discussed in detail. It now remains to examine these components from a systems viewpoint - to point out areas where past experience has shown that variation from the requirements will produce an equivalent degree of safety. It is also necessary to develop recommendations for some specific applications not addressed by the regulations.

A function of structural fire protection within accommodations and service areas is to provide a separation between areas of varying fire hazard. A major degree of separation must always be provided between high hazard spaces, such as cargo holds or machinery spaces. and acclamations areas. secondly. adequate means of escape must be provided to permit trapped personnel to safely exit from untenable areas during periods of fire exposure.

Additional precautions are necessary to insure that the spread of fire is not propagated in concealed areas or in shafts or trunks which interconnect several areas.

Potential fire hazards within accommodations and service areas should be located as remote from sleeping areas as practicable. Such hazards include emergency generator rooms, galleys, or paint lockers or other areas. Normally, the boundary bulkheads and decks of all such spaces within the accommodation areas are A-Class. The only exceptions to these are small service lockers, lounges. and mess areas. (Small service lockers are regarded as any locker with less than 50 square feet of floor area, not having provisions for the stowage of flammable liquids.)

Many times mess areas are located adjacent to galleys. The bulkhead separating these two areas is required to be A-Class. If a galley serving window is installed in this bulkhead, it must be capable of meeting A-Class requirements. Normally, a rolling steel fire door, operable from outside the galley or mess area, and which is rated for 1-1/2 hours or more (NFPA 252, UL 10(b)) is acceptable. Alternatively, the galley and mess area may both be surrounded by A-Class bulkheads and doors, and appropriate fire dampers included in the ventilation system.

Refrigerated Spaces

Aboard cargo and tank vessels, reefer spaces which are contiguous with accommodations and service areas are considered as being within those areas. The regulations therefore specify non-combustible thermal insulation. Aboard passenger vessels, combustible insulations are permitted by 46 CFR 72.05-40; however, a reefer apace which is a tape 9 space must be separated from type 5.6, or 7 spaces by A-Class bulkheads. It is therefore felt that aboard cargo and tank vessels, combustible reefer insulations Ray be used if the compartment is separated from the remainder of the accommodations by A-Class bulkheads and doors.

Fan Rooms

Pan rooms within accommodation and service areas which contain an aggregate horsepower greater than 10 hp are considered high hazard areas and should be surrounded by A-Class bulkheads and decks. These fan rooms are not necessarily considered hazardous because of the machinery installed, but because of the potential area of service. Fan rooms of greater than 10 hp could service a large accommodations area, and could provide an avenue for extensive fire and smoke spread.

Combustible Materials within Concealed Spaces

As previously mentioned, the spread of flame in concealed areas is a matter of great concern. The current regulations prohibit the installation of any materials which are not approved materials in concealed spaces. This prevents the use of plastic piping and ductwork. Exemptions from this requirement, however. have been permitted. Approved electrical wiring which meets the provisions of the fire test in IEEE standard 45 is acceptable because there are few practical non-combustible wiring insulations. Additionally, other widely spaced, small amounts of combustible materials can be accepted on a case-by-case basis. Materials such as sound-deadening inserts on pipe hangers, figure 3.6.1, plastic cable ties, figure 3.6.2, and plastic shrink-fitting joint seals on ductwork have been accepted. However, the use of combustible materials in such areas must be kept to a minimum and should be discouraged. In no case should combustible interior finishes be installed in concealed spaces.

4.0 Special Service Passenger Vessels

4.1 Ferry Vessels

Ferry vessels are a unique form of passenger vessel in that they usually carry vehicles, generally do not have overnight accommodations, and are. in most cases, dedicated to specific routes of fairly short duration and high passenger density. structural fire protection for these vessels is important because of the large number of passengers that are carried in relation to the vessel's size. If vehicles are carried, added precautions are considered necessary to provide an effective structural fire protection boundary between the vehicle and passenger areas. Passenger ferry vessels over 100 gross tons are required to comply with the structural fire protection regulations in 46 CFR Subchapter N (Passenger Vessels). Perry vessels of 100 gross tons and less which carry more than 150 passenger! are required to comply with the same requirements as determined by the cognizant OCMI.

Because "any ferry vessels are different in design than traditional passenger vessels, it is necessary to examine the structural fire protection requirements and determine their applicability to specific ferry vessel arrangements.

The following definitions have been developed to clarify the technology used in the regulations:

(1) Spaces specially suitable for vehicles - These are spaces which are designed for the carriage of automobiles or other self-propelled vehicles with connected batteries and fuel tanks containing gasoline on ocean or unlimited coastwise voyages. It is generally intended that these spaces are below deck and are inaccessible during the voyage; however, any such as above the weatherdeck enclosed on four sides with an overhead is also considered a space specially suitable for vehicles (type 11 space)

(2) Vehicular Deck - These are spaces which are designed for the carriage of automobiles or other self-propelled vehicles which (1) are above the weatherdeck. (2) are not enclosed on four sides. or (3) which do not have a total overhead deck, such as a partial overhead. They may or may not be accessible to passengers during the voyage (type 11 space if inaccessible, type 7 space if accessible)

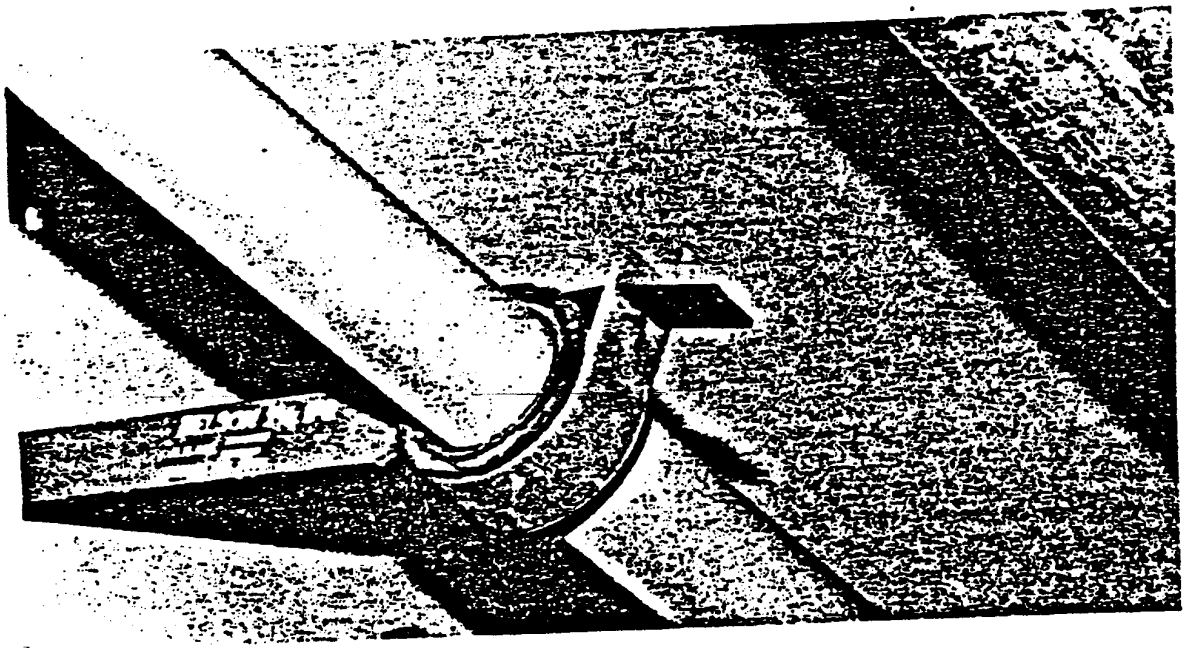


Figure 3.6.1-Plastic Sound Deadening Insert on Pipe Hanger.

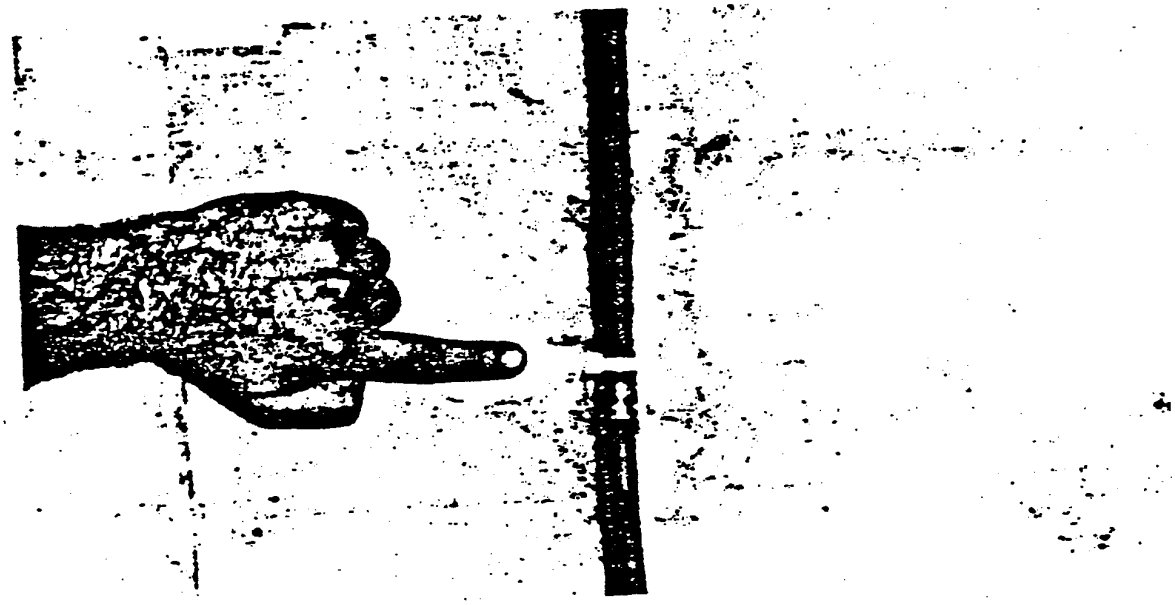


Figure 3.6.2-Widely Spaced Plastic Cable Ties.

Main Vertical Zones

Perry vessels over 131 ft. in length which are built to the requirements of ~6 ~ subchapter N must be subdivided by main vertical zones. This requirement is unrealistic for the protection of vehicle decks. To provide an equivalent degree of protection as main vertical zone bulkheads, both the vehicle deck and the deck above are designated as main vertical zone decks and must comply with the construction requirements of table 46 CFR 72.05-10(f). An additional consideration for accessible vehicle decks concerns the available means of escape. In order to comply with the intent of 46 CFR 72.05-20(f), stairtowers may not give direct access to vehicle decks. but should communicate with a corridor or foyer onto the vehicle deck. in lieu of this requirement. double doors may be provided on the stairtower exits.

Canopies and Solariums

A number of ferry vessel designs incorporate an observation area on the uppermost deck. Such an arrangement is acceptable under the scope of the current passenger vessel regulations within certain limitations. Normally. if any spot on a canopy is over 15 feet from the nearest permanent opening to the weather, the deck area is considered an enclosed space and, as such, must be constructed of noncombustible materials. If it can be assured that the permanent fuel load in such a space is .5 lb/ft^2 or less and two means of escape are readily available, the use of combustible materials such as plexiglas for the canopy could be acceptable as an alternative.

4.2 Dynamically Supported Craft

Dynamically-supported craft, by their very nature, are different from a displacement-type vessel. This is seen in the use of the principles of aircraft dynamics in the design and the use of relatively short routes catering to passengers desiring shorter travel times. These parameters result in a craft that is unique from the point of view of applying structural fire protection regulations which have been developed for displacement-type hulls.

Coast Guard fire protection requirements for hydrofoils and hoveraraft have been developed on the principle that a level of safety equivalent to that normally expected on ships complying with Coast Guard rules and the International Convention for Safety of Life at Sea (SOXAS) can be achieved, provided that all aspects of contraction, operation, maintenance, and supervision are regulated. This provides for placement of appropriate restrictions on the length and of the route of service, the sea state suitable for operation, communication facilities, reasonable proximity to a place of refuge, and the availability of rescue services.

To date, requirements for structural fire protection aboard hovercraft and hydrofoils have been determined by applying sections of 46 CFR subchapter H on a case-by-case basis. These regulations are intended for large, oceangoing vessels, with the philosophy that, until a fire reaches a stage of near-total involvement, the vessel serves as a safe refuge for all persons aboard. 8au'e of the principles included in this traditional approach to structural fire protection include;

(1) Division of the ship into main vertical zones;

(2) Containment and extinction of any fire in the space of origin; and

(3) Protection of means of escape or access for firefighting purposes.

A re-examination of these requirements, when applied to hovercraft and hydrofoils, indicates that such an approach may not necessarily produce an equivalent degree of safety without seriously impairing the operational concepts of these types of vessels. Because of their intended coastwise service, hydrofoils generally carry a large number of seated passengers, with no overnight accommodations. Such an arrangement offers limited areas of refuge. If a fire were to occur. evacuation of passengers would be required shortly after fire fighting efforts were begun. One acceptable structural fire protection philosophy for hydrofoils and similar vessels is based upon the concept of providing sufficient fire endurance time to allow evacuation of the craft. while restricting all furniture and furnishings to those of law flame spread or low fire risk. Such an approach my be considered acceptable. dependent upon the general passenger-carrying procedures followed aboard such types of craft. For example; many such vessels are divided into a number of passenger salons with attendants. in each, and the craft is in frequent radio contact with the home port. Any outbreak of fire would be rapidly detected, and the passengers evacuated with the knowledge that rescue vessels will arrive in a reasonable time period. The crew is than free to attempt extinguishment of the fire, while awaiting for rescue.

The use of traditional structural fire protection materials and requirements aboard high-speed craft could be unnecessarily weight restrictive. Trade-offs can therefore be made to provide an equivalent degree of fire protection capability for the specific service intended. The fire protection regulations in 46 CFR subchapter H (Passenger Vessels) require specific fire-endurance ratings far all bulkheads and decks. These regulations are based upon the consideration that a passenger vessel will be an oceangoing vessel and its own best lifeboat, and that attempts will be made by the crew to extinguish any outbreaks of fire prior to abandonment of the ship.. Greater fire-endurance properties of bulkheads and decks are therefore needed to provide areas of refuge for the passengers and crew.

The philosophy of structural fire protection which has been applied to hydrofoils on a case-by-case basis. considers the vessel as being divided into three major areas:

(1) machinery spaces;
(2) control stations; and
(3) passenger areas.

Depending on arrangement, specified structural fire protection measures may be required only for the bulkheads and decks which separate these three major areas. A-30 Class bulkheads and decks are recommended as a minimum for these divisions. Another factor influencing the need for structural insulation is the use of aluminum. While no insulation may be required between two passenger decks, means must be provided to prevent the collapse of overhead decks during periods of fire exposure. This generally requires some form of insulation on stanchions or other aluminum structural members.

Another element of the structural fire protection system for hydrofoils concerns furniture and furnishings. To prevent rapid flame spread in passenger areas, materials which exhibit low flame spread and smoke emission characteristics may be required. The requirements which have been utilized thus far are even more stringent than the requirements for fire resistant furnishings. ~e following test requirements have been previously accepted:

(1) Seat cushions must pass the AST?I 3 162-76 Radiant Panel Test with a flame propagation index not exceeding 25. No specimen flaming runnings or drippings may occur during testing. Wire mesh screening must be used as per Section 5.9.2

of the test. A 6 inch long pilot flame Rust be provided. The burner tip must be situated 1 ¼ inches beyond the frame to prevent extinguishment. Aluminum foil must be used as wrapping around the back sides of the specimen.

By additional test or analysis, the fire resistant properties of seat cushion material Rust be shown to be an integral part of the material.

(2) Interior textiles must be tested in accordance with the procedures in Appendix F to 46 CFR 25. The following criteria apply in conducting these tests:

(a) The average flame time after removal of the flame source must not exceed 10 seconds.

(b) Burn length Rust not exceed 2.5 inches.

(c) Drippings from the test specimen must not flame.

Fabrics that Rust be machine washed or dry cleaned Rust meet the criteria in paragraphs 3 (i) (ii), and (iii) above after leaching in accordance with Federal Test Method Standard 191b, Method 5930, or after dry cleaning in accordance with AATCC-86-1966.

Fabrics that cannot he machine washed or dry cleaned must be so labeled and pass the leaching test in FTM Standard 19lb, Method 5830, and must meet the test criteria in paragraphs B (i), (ii), and (iii) above after being cleaned as recommended by the manufacturer.

(3) carpeting must he tested with its padding if the latter is to be used, and must be capable of passing the NBS Flooring Radiant Panel Test (NFPA 253-1978) with a minimum critical radiant flux of 0. 6 watts/cm^2.

(4) Interior textiles and carpeting must also be tested for smoke emission in accordance with NYPA 258-1976 “Test Method for Measuring the Smoke Generation by Solid Materials”. When conducting this test, the optical density, D, in both flaming and non-flaming modes must be determined and may not exceed 100. until at least 4 minutes after start of the test.

5.0 Tank Vessels

Additional structural fire protection measures are required aboard 'tank vessels to protect the deckhouse or other accommodation spaces adjacent to the cargo area from deck fires. Actual experience has shown that a deck fire of extreme duration and intensity is possible aboard a tank vessel. In the event that such a fire were to occur, it is imperative that the deckhouse be adequately protected to allow the crew a safe refuge and coordination area for firefighting activities.

The Coast Guard design approach provides an A-60 Class barrier on the deckhouse or superstructure. (This requirement does not apply' to forecastle spaces containing only isolated storage spaces. Isolated storage spaces do not contain accommodation or control spaces. Therefore, 46 CFR 32.56-20 and 46 CFR 32.56-21 are not applicable.)

No openings leading to accommodation service or control spaces are permitted in the deckhouse. With the exception of the navigation bridge, all portlights must he of fixed or non-opening types with 11 USSG

minimum steel covers operable from the interior. These requirements are applied to the boundaries facing the cargo area as well as the side of the deckhouse or superstructure for several feet aft, depending on the type of tank vessel. Further details are contained in the regulations as follows:

(a) Subchapter D - 46 CYR 30-40 “Tank Vessels”;

(b) Subchapter 0 - 46 CFR 153 “Safety Rules for Self-propelled Vessels carrying Hazardous Materials”;

(c) Subchapter 0 - 46 CFR 154 “Safety Standards for Self-propelled Vessels carrying Hulk Liquefied Gases; Special Interim Regulations for Issuance of Letters of compliance to Barges and Existing Liquefied Gas Vessels.”

6.0 Aluminum Construction

The information contained in the Society of Naval Architects and Marine Engineers' Technical and Research Bulletin 2-21 is a listing of acceptable methods of insulating aluminum bulkheads and decks to achieve the fire endurance required by Coast Guard regulations. This bulletin is a result of full scale tests, developed by the Fire Test M Hoc Subgroup Task Group HS-6-l (Aluminum) of the Hull structure Committee. inasmuch as this report was prepared under joint Coast Guard sponsorship, it is acceptable guidance for the review and planning of aluminum construction methods for bulkhead and deck assemblies. Additional structural fire protection considerations such as penetration protection and arrangement details are contained in this section.

Aluminum construction is considered acceptable for internal divisions within accommodations services and control spaces on all vessels with the following exceptions:

(1) category A machinery space boundaries including trunks must be steel.

(2) Except for C-class divisions, aluminum construction by not be used aboard tank vessels.

(3) Total aluminum construction will be permitted for small passenger (46 CFR subchapter T) and oceanographic (subchapter U) vessels.

(4) Aluminum superstructures may be utilized on cargo and miscellaneous (Subchapter I) and passenger (Subchapter H) vessels.

The use of aluminum in other areas is subject to special consideration.

Methods for insulating aluminum construction differ from those for steel assemblies for several basic reasons. When considering either steel or aluminum, one hour is the longest period of time any assembly is required to maintain its integrity under fire conditions. By examining the standard time-temperature curve (the standard by which insulation assemblies are evaluated) we find that after one hour, the expected temperature in the fire zone is in the range of 1700^0F. For steel bulkheads and decks, this temperature is below the selling point of the steel; thus, if a fir. should occur on either side of a steel partition. structural integrity will be maintained. Structural insulations, if required, need be installed on only one side of a steel division. For aluminum however, a different situation exists. To maintain its structural integrity under fire conditions for more than several minutes, the aluminum must be insulated to keep the aluminum core temperature below 450^0F (232^0C). Although the melting point is much higher, failure of aluminum plating under loaded conditions may occur at this temperature.

Since it cannot be predetermined from which side fire exposure will occur, insulation must be applied to the aluminum so that it will be sufficiently protected to withstand a 1-hour fire exposure from either side, except in cases where exposure from only one side is possible. In addition. extra structural insulation must be installed to limit the heat transfer through the assembly to maintain specified temperatures on the unexposed side of the assembly where required. This additional insulation must be applied in a specific manner. Extra insulation may actually decrease the fire endurance of the assembly.

An 11 USSG steel plate without insulation is rated as A-O Class; however, an aluminum plate (minimum thickness of 3/16") must have an insulation value (F_c) of 72 S to be rated as A-O. The A-O Class steel plate can be changed to A-15, A-30 or A-60 Class by adding some pre-determined thickness of approved structural insulation, but the aluminum A-O Class assembly, which already includes some amount of structural insulation, cannot he changed to A-15, A-30 Class, or A-60 by the same process. on pages 6 and 7 of S?IRME Bulletin 2-21, an explanation is given detailing how the insulating value of an aluminum assembly is affected by increasing the amount of applied structural insulation. Depending upon the configuration of the insulation and aluminum plate, the insulating value of the assembly may increase or decrease. As a result, bulkhead and deck assemblies can be constructed which will have different fire-endurance capability, depending upon which side of the assembly is exposed to fire. Appendix C of SNAME Bulletin 2-21 depicts a variety of bulkhead and deck assemblies, showing the total insulating value of the assembly (ft), and the core insulating value (P_c) provided by the insulation on each side of the aluminum plate. Simply stated. the (Pc) value determines whether the assembly is A-. B-, or C-class, and the (F_t) value determines whether the assembly can be rated A-0, A-15. A-30, or A-60 Class.

When planning aluminum construction, formidable amounts of insulation may be required to comply with the current regulations for structural fire protection. For example. consider that a common bulkhead separating two spaces is required to be A-60 Class. If it cannot be positively stated whether the likelihood of fire is greater in one space of the other, A-60 Class capability Rust be provided on <u>both</u> sides of the bulkhead. This degree of protection may not be necessary in all cases, and the following alternative approach could be used on a case-by-case basis. If, by using the fire loading survey technique explained on pages 10 through 15 of SNAME Bulletin 2-21, it can be determined that the fire loading of the two spaces is insufficient to warrant A-60 Class protection on both sides of the bulkhead, a lower insulation value may be used on one side. To maintain the intent of the regulations. one side of the bulkhead should still be insulated to A-60 standards. The various subchapters of 46 CFR should be consulted to determine the amount of fire endurance necessary for each bulkhead and deck. A fire loading study can then be made. The required degree of insulation is then installed on the side of the bulkhead Or deck facing the space with the more severe fire loading. The insulation value for the remaining side of the assembly is then calculated, based on the lower fire loading of that space. Several exception to this method are noted as follows:

(1) For certain spaces, it is desirable to provide insulation to prevent the spread of fire into the space. such spaces include control stations. spaces containing fire extinguishing equipment, escape routes and spaces adjoining machinery spaces, and emergency generator and battery rooms. For these spaces, the degree of protection required by the regulations should be on the exterior boundary of the space. The interior side insulation value is then based on the fire loading inside the special category space.

(2) The underside of all decks, except weatherdecks. should be insulated to a minimum A-0 Class requirement.

(3) 3ulkheads and decks separating water tanks, void spaces, and ballast tanks from open deck areas need not be insulated. Fuel tank boundaries should be insulated only on the external

side. Fuel tank boundaries should meet a minim A-0 requirement and should be increased accordingl7, depending upon the fire loading of the adjacent space.

(4) The overhead and sides of non load-bearing canopy decks, that serve only as protection from the elements, do not require insulation. If the overhead 0£ such a canopy deck supports a load such as lifesaving equipment, passengers etc., the overhead, sides. and supporting structure should be insulated in accordance with the following table:

Fire Load	F_C Value
less than 0.5	0
0.5 to 1.99	0.25 s
2.0 to 4.99	0.45 s
4.5 to 6.99	0.61 s
7.0 and greater	0.72 s

(5) Bulkheads and decks separating passenger spaces and open spaces (not safety areas) should be insulated on the internal side in accordance with the above table.

(6) Shell plating and framing below the main deck should be insulated to A-0 Class standards for a distance at least 12 inches below the lightship waterline. Voids or other spaces with a fire load of .51b/ft^2 or less need not be insulated.

(7) Insulation in machinery spaces or other spaces where oil fuel is used should be provided with a vapor barrier, and should not extend into the bilge area where it could become oil soaked.

Care should he taken in applying materials other than those required. Additional approved bulkhead panels, structural insulations, deck coverings, or noncombustible material, may not be used without restriction, because their use bay actually decrease the fire endurance of the assembly.

Aluminum Bulkhead and Deck Penetrations

As with steel bulkheads and decks, penetrations of aluminum bulkheads and decks must be sealed to maintain the integrity of the division. Where the penetration is made by aluminum pipe or ducting, etc., similar methods may be employed as for steel. ~ difficulty arises when ferrous or other non-aluminum materials penetrate aluminum divisions. Because of corrosion problems due to the contact of dissimilar metals, a means of isolation must be provided between the steel penetration and the aluminum divisions. This insulating material must be carefully evaluated in regard to its fire endurance. Depending upon the arrangement of the penetration, trade offs may be made on a case-by-case basis to insure an acceptable method.

7.0 Structural Fire Protection Review Procedures

(1) Determine the applicable regulations - Table 3.0 is a ready reference of where to look within the following regulations:

46 CFR 32.57 - Tank Vessels

46 CFR 72.05 - Passenger Vessels

46 CPR 92.05 - Cargo & Miscellaneous Vessels

46 CFR 72.05 - Small Passenger Vessels which carry over 150 passengers

46 CFR 177.05- Small Passenger Vessels which carry less than 150 passengers

(2) Determine if the vessel will be steel or aluminum. If aluminum, see Section 6 before proceeding.

(3) Review the proposed materials list to determine if approved materials are provided. Consult CG-190 or approved equipment card file for approval numbers

164.006/X - Dock coverings

164.007/X - Structural insulation

164.008/X - Bulkhead panels

164.009/X - Non-combustible materials

164.012/X - Interior finish materials

164.035/X - Fire retardant resins

Non-approved materials should be rejected, or Commandant (G-MMT-3) (tel. 202-426-1444) should be. consulted to determine acceptability of alternate materials.

“Fire-Resistant” materials do not have a type approval. Test data from UL or other independent laboratories should be submitted to verify the materials ability to pass the following tests:

Fire Resistant Fabric -	46 CFR 164.011 or NFPA 701 (large & small tests)
Fire Resistant Cushions -	ASTM - D1692 (self-extinguishing or extent of burning (less than 5 inches)
Wool or equivalent carpets and underpads -	ASTM E-84, Flamespread less than 75, smoke developed less than 100

Review general arrangement plan for use of non-combustible materials within accommodations and service areas. The following are required to be non-combustible:

- bulkheads and decks
- doors, frames. related hardware
- stairs
- ceilings
- linings and draft stops
- insulations (see Sec. 3.6 on Reefers)

- duct and pipe laggings
- trim, veneers. decorations, etc. in corridors, stairways or hidden spaces

- room dividers or partial bulkheads
all materials which are used to secure any of the above

NOTE: Type approved materials are non-combustible. Approved deck coverings and approved interior finish material are determined to have an acceptable level of combustibility when installed in approved locations and thickness.

• Review general arrangement plan to determine if bulkhead and deck classifications are acceptable. (e.g.. stairtower A-0, machinery space casing - A-60, etc.). Requirements are found in construction and arrangement regulations determined in step 1.

• Review each type bulkhead and deck to determine if the required fire endurance (A-0, A-60, etc.) can be achieved with the insulating scheme proposed. Sketches of tested bulkhead insulating methods are in section 3e 1. Sketches of tested deck assemblies are in Section 3.2. Any other arrangements cannot be accepted without specific approval of Commandant (G-MMT-3) (tel. 202-426-1444) or Commandant (G-MMT-4) (202-426-2197).

• Check proposed installation method of approved structural insulations (164.007). Mechanical steel fasteners must be used. Spacing of fasteners must be limited as specified in section 3.1. Insulation should wrap around corners twelve inches to prevent heat transfer. Penetration of insulated bulkheads and decks must be insulated for twelve inches along penetration.

• Check proposed installation method for bulkhead panels. Joiner work system must be identical to that on approved plans. All connectors mist be steel.

NOTE: Approved joinerwork plans are kept on file in conjunction with approval card. Details are in Section 3.2.

• Check installation of draft stops in void spaces between bulkhead panels and steel bulkheads and decks. (Required for passenger and tank vessels.)

• Check proposed deck coverings. Approved 164.006 materials must be used in specified thickness. Where latex or other mastics are used to bond the deck covering to the deck, it must be noted on the approval card. 318" thickness overlay of any material is permitted.

• Determine if rugs and carpets Rust be "wool or equivalent". See Section 3.2 and regulation in step 1.

• Check interior finish materials. 2128" thickness of any "material is permitted on bulkheads. linings and ceilings except in corridors, stairways and hidden spaces. Where 164.012 materials are required, adhesives or other fasteners must be as noted on the approval card.

• Check penetration details of all piping, wiring and ductwork. Steel A-Class bulkheads and decks must be positively sealed to prevent passage of smoke and flame. 3-Class bulkhead penetration Rust be as tight as possible.

• Check ventilation drawings to determine if fire dampers are provided at bulkhead and deck penetration. Thickness of steel and routing of duct must be considered. See Section 3.4.

• Check construction of doors and frames Louvers my be installed in B-Class doors.

• Check windows and portlight construction. Wire inserted glass and steel covers my be required. Steel retaining clips are required on aluminum frames.

• Check furniture and furnishings of each space.

• Determine if two means of escape are available from each area.

• Check stairways to determine if stairtowers should be provided.

• Check tonnage openings. Steel tonnage openings are required in A-Class bulkheads.

• Review regulations determined in Step 1 to ascertain if any additional requirements exist.